SCIENCE

22 November 1957

Volume 126, Number 32

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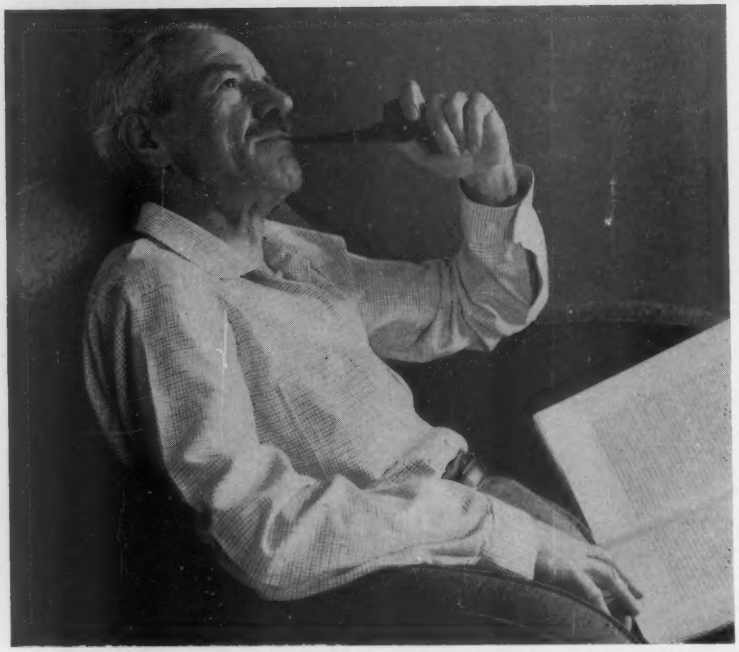

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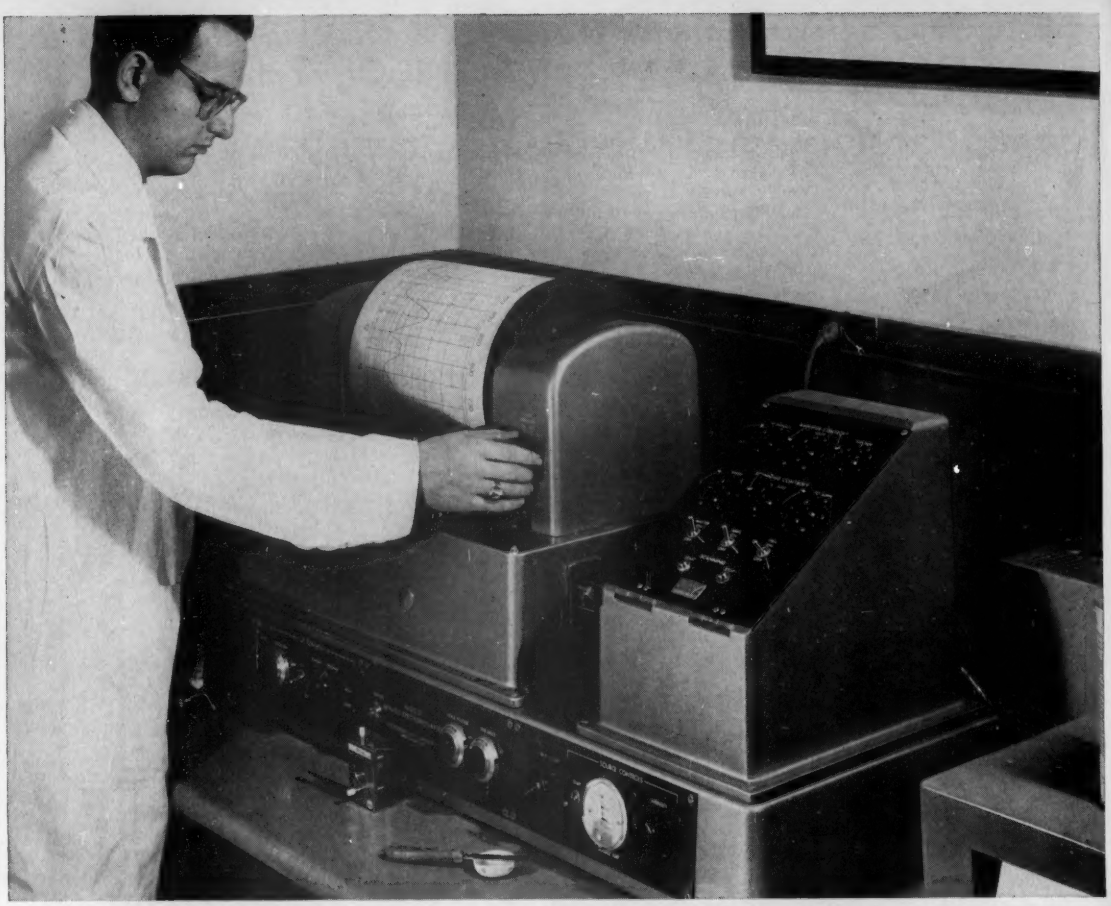

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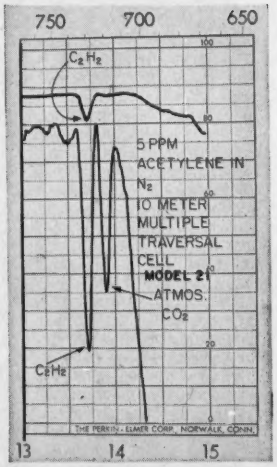

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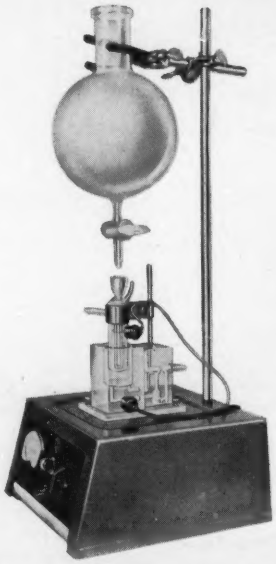

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SCIENCE

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Know It Now

A new television series about science, called "Conquest," will have its debut on Sunday afternoon, 1 December 1957, 5 to 6 E.S.T., on the CBS network. Sponsored by the Monsanto Chemical Company, the series is being developed by the Public Affairs Department of the Columbia Broadcasting System with the assistance of representatives of the AAAS and of the National Academy of Sciences. "Conquest" will attempt to give a general audience the beginning of an understanding of today's achievements in biology, physics, and the other branches of science.

Presenting scientific knowledge to a nonscientific audience has its own special pitfalls. Something in the way of a come-on is necessary, and one place to go wrong is to choose a come-on, which, for the very reason that it has a broad appeal, has little to do with the prime purpose of the show. At its extreme, this kind of error is like the old burlesque routine in which a "Professor" plays the xylophone at the front of the stage, while at the back, unknown to him, an energetic young lady does a strip-tease. The laughs develop because the "Professor" thinks, as he obliges with encore after encore, that the ever-mounting applause is meant for him. But it is not the concert for which the audience came, and it is not the concert that the audience will remember.

As far as we can judge from advance reports, "Conquest" has found a way to let public interest in the series develop from elements intrinsic to science. The show will be in the straight-from-life genre; it will report directly from laboratories, field stations, and testing grounds. This approach is promising for two reasons. First, people at leisure always like to watch people at work. Second, the chronicle of science in the making—its suspense, its failures, its successes—should make for effective drama.

The contents of the first hour—three more shows are scheduled for the early part of next year—are as follows: opening statement by the president of Monsanto; introductory remarks by Eric Sevareid, the host for the series; "Edge of Life," a special film about microbiology, which concludes with some interpretive comments by W. M. Stanley; a photographic account of oceanographic research as conducted by Maurice Ewing and his associates from the Lamont Geological Observatory; exclusive films of Major David Simons' recent record-breaking balloon ascent of 20 miles; and, finally, an interview on the state of science with Detlev W. Bronk, Laurence H. Snyder, and Alan T. Waterman. The hello's and goodbye's, commercials, and other odds and ends make up the rest of the hour.

Participation in "Conquest" by representatives of the AAAS is one of the several ways in which the Association is expanding its public information services. Whatever faults and virtues the first show in the series turns out to possess, the chances are good that it will not make the mistake of offering so much by way of inducement that there is no seeing the science for the television.—J.T.

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Fresh-Water Diatoms from Atlantic Deep-Sea Sediments

R. W. Kolbe

Nine years ago the Swedish Deep-Sea Expedition 1947–48, under the leadership of H. Pettersson, completed its cruise around the world. The object of the expedition was to make investigations mainly in the tropical belt of the Pacific, Indian, and Atlantic oceans. One of the most important aims of the expedition was the investigation of deep-sea sediments in cores reaching as deep as modern coring technique would allow.

It is well known that the mere securing of ooze and mud from great depths requires a complicated technique. The difficulties increase if it is necessary to secure long cores of undisturbed sediment, as is required for geological, geochemical, and geophysical purposes. Cores obtained by the earlier coring technique seldom exceeded a length of 2 meters, the longest core measuring about 3 meters.

The expedition used a new coring technique developed by Kullenberg (*1*); his piston corer made it possible to obtain cores of record length—in soft sediment, up to 20 meters and more; in relatively hard oceanic sediments the length of the cores averaged about 12 meters. When the slow rate of sedimentation (from 0.5 to 8 centimeters in 1000 years) was taken into consideration, it was determined that some of the cores collected by the expedition reached the Tertiary. On board and after the return of the expedition, the cores were kept in cold-storage rooms, and sections of them were distributed to specialists for further investigations. I was commissioned with the investigation of the diatoms contained in the cores.

Diatoms are autotrophic plants—that is, plants that do not require organic nutrients. Their nutrition is based essentially on a process of assimilation of carbon dioxide under the influence of light. Consequently, the life-cycle of these plants is restricted to the upper strata of the oceans, because light of sufficient intensity does not penetrate more than a few hundred meters below the surface of the sea. Diatoms are the main component of marine plankton and the principal, primary source of food of pelagic animals such as protozoans and microscopic crustaceans, which, in their turn, are eaten by larger animals: larger crustaceans, coelenterates, worms, mollusks, pteropods, fish, and finally marine mammals. After the death of the diatoms or their passing through the digestive system of animals, their siliceous valves slowly sink to the sea floor, together with mineral particles and remains of other pelagic organisms. This slow, but constant, fine rain of particles is responsible for the formation of oceanic sediments (at least in the deep sea).

During their settling, the valves are exposed to the dissolving effects of sea water; although they are generally resistant (but by no means "indestructible," as is often asserted in textbooks), they are sensitive to high *p*H values (alkaline reaction of sea water). A kind of physicochemical selection takes place, valves of delicate pelagic diatoms being more easily dissolved than those of thick-walled species, and my investigations have shown that the diatom assemblages of the sea floor differ substantially from planktonic communities. The sea-floor assemblages are poor in thin-walled species, completely lack the delicate pelagic forms, and are relatively rich in coarse species, including ones that are scarce in the plankton community. An interesting fact was disclosed: the diatom assemblages of the sea floor of the tropical belt of all oceans are surprisingly uniform.

Still, there were exceptions. Some long cores, for instance, contained at their lowest levels diatoms which have long been extinct. An identification of the species showed that the corer had secured sediments formed as early as during the last phases of the Tertiary (*2*).

One of the most interesting observations was the unexpected presence of many fresh-water diatoms in certain cores taken by the expedition's ship *Albatross* parallel to the coast line of Equatorial West Africa at a great distance off the coast (see Fig. 1).

Location of Finds

The finding of stray specimens of fresh-water diatoms in deep-sea sediments is not an entirely new fact in itself. Lohman (*3*) and some earlier observers reported a few fresh-water diatom species from deep-sea soundings; in most cases, however, these finds were rare, and only a few single valves were encountered. My own investigations of the numerous cores collected by the Swedish Deep-Sea Expedition in the equatorial belt of the Pacific and Indian oceans did not reveal a single specimen of fresh-water species, except in the close vicinity of continents or large islands.

The novelty of the present observations lies in the constant occurrence of fresh-water diatoms in Atlantic deep-sea cores, the large number of individuals, and the relatively great variety of species. More than 60 fresh-water species, belonging to various ecological groups, were observed: plankton and benthonic forms, species typical for habitats rich in nutrients and even for some poor in nutrients, most forms being common cosmopolites—that is, species of world-wide distribution (Fig. 2).

In most levels, only a few (5 to 50) valves in a small, given volume of sediment could be observed: in others the frequency was great to very great. The

Dr. Kolbe is research associate at the paleobotanical department of the Swedish Museum of Natural History and lecturer in diatomology at the University of Stockholm.

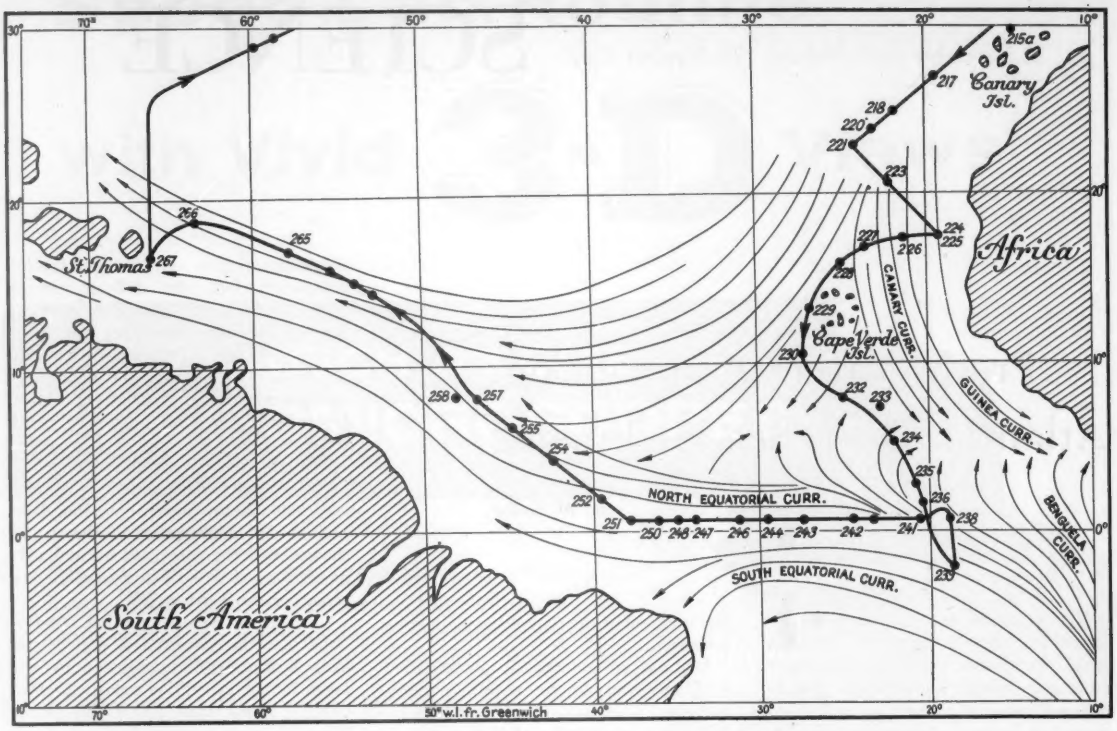

Fig. 1. Atlantic cruise of the *Albatross*. The numbers by the side of small circles are core numbers.

most frequent fresh-water diatom was *Melosira granulata* (Ehr.) Ralfs, with its varieties. Incidentally, its frequency was surprising; this sometimes amounted to more than 1000 valves per slide, and in one sample about 3600 valves per slide could be counted. A certain level (552 centimeters below the top of core 234) deserves special mention; it contained fresh-water diatoms exclusively, the only exception being a single fragment of a marine form. With regard to diatoms, this level gave the impression of belonging to a fresh-water sediment. In addition to the ever-present *Melosira granulata,* as many as 17 fresh-water species could be observed in this level. This "fresh-water community" seemed to be confined to a thin stratum; the next higher level contained only a few individuals of *Melosira granulata* and the usual marine assemblage, while all the levels below this thin stratum and down to the end of the core (1351 centimeters) were totally devoid of diatoms.

Cores remarkable for the highest frequency of *Melosira granulata* are those with the numbers 229, 230, 234, 235, and 238 (from Romanche Deep, 7315 meters, one of the greatest depths in the Atlantic, named after the French frigate *Romanche,* which discovered it). The localities represented by these cores surely cannot be considered "near-shore" stations. Table 1 shows the approximate distances from the nearest continents for three of these cores.

An observation concerning another group of objects of nonoceanic origin may be pointed out: the regular and rather frequent occurrence of silicified epidermal cells belonging to terrestrial plants (Cyperaceae and Gramineae) in many cores. These characteristic small objects are the replicas of short epidermal cells whose whole interior becomes filled with silica during the life of the plant. The compact siliceous "casts" are obviously highly resistant to the corroding effects of sea water. They are to be found in fresh-water sediments and sometimes in near-shore marine deposits but, to my knowledge, are not known in deep-sea sediments. In Atlantic cores they occurred together with *Melosira granulata* and were almost as common as this form.

Table 1. Approximate distances from nearest continents of three cores taken by the *Albatross* parallel to the coast line of Equatorial West Africa.

Core No.	Geographic position	Distance (km) from	
		Africa	South America
234	N5°45′, W21°43′	930	1960
235	N3°12′, W20°25′	990	1900
238	S0° 7′, W18°12′	1050	1990

Origin of Fresh-Water Diatoms

Let us consider the possible explanations for the presence of fresh-water diatoms in the depths of the Atlantic, far from their present-day natural habitats. It is evident that these forms are allochthonous—that is, were transferred to their place of deposition and cannot have existed in the ocean. Where did the fresh-water diatoms come from and by what means of transportation were they removed from their natural habitats, carried away, and deposited at distant parts of the sea floor? In view of the great frequency of occurrence of fresh-water diatoms (at least in certain sediments), it is likely that great quantities of fresh-water material must have been (and probably are still being) conveyed over many hundreds of miles of sea.

The most obvious and natural explanation seems to be the transport by rivers and sea currents (potamic transport). Africa, from the Gulf of Guinea to the system of the Congo, is a country of

lakes, rivers, swamps, and so on, presenting good living conditions for diatoms of various ecological types. Great rivers—the Niger, the Congo—and a multitude of tributaries, small streams, and rivulets carry enormous quantities of living diatoms and their valves towards the sea—in the present case, towards the Gulf of Guinea. Once at sea, dead and dying fresh-water forms, other organic remains, and mineral particles are taken up by sea currents. In the present case, the currents in question are the Benguela, the Guinea, and the South Equatorial currents, the complicated countercurrents, and the circulation, turbidity, and convection currents. Under the combined influence of these current systems, the valves move slowly, both downwards and horizontally, until they sink through the so-called "oceanic troposphere" (*4*) and reach the abyssal zone—the "bathysphere," an immense volume of practically undisturbed water which allows the valves to sink with hardly any horizontal locomotion—where they finally come to rest on the sea floor.

As for the place of deposition, it is at present impossible to guess the distance that can be traveled or the direction that can be taken by the diatoms during their settling process. The settling time, or period of their sinking through the troposphere, is an unknown factor; attempts to determine the settling velocity, even in undisturbed water, have differed widely, and the whole question becomes more complicated if the influence of complex and little-known hydrodynamic factors connected with the current systems is considered.

It is possible that there is another means of transportation: transport by wind and sea currents (aeolian transport). The transportation of great quantities of diatoms by wind would not seem very probable were it not for the particular geographic position of the majority of the cores in question. The following paragraphs are quoted from my report on the Atlantic cores (*5*).

"The West Coast of Africa is entirely in the zone of influence of the desert winds which periodically carry large quantities of fine sand and dust particles [*6–8*]. The strong influence of the dust storms is best illustrated by the ill fame of certain parts of the Atlantic near and south of the Cape Verde Islands. Early navigators feared this near-shore part of the Atlantic (from about lat. 30°N to lat. 5°S) and this sector was named 'the Dark Sea,' 'Dunkelmeer,' and 'Pot-au-Noir.' At certain periods the fine dust carried by the NE trade wind blowing from the Sahara Desert produces a haze, reducing the visibility at sea to 1–2 km and in some cases even to 150 m (Pratje) [*9*]. . . . According to this author, from whose paper I summarize the following information, the Sahara dust has been analyzed and found to contain mineral particles only. The Sahara dust is responsible for some mineral sediments in the deep-sea cores, but probably not for the freshwater diatoms which these cores contain.

"South of the district discussed and overlapping it, another dust phenomenon is well known, although not so feared as the Sahara haze. It is the 'Harmattan' haze; it is also caused by the NE Trade. Its zone extends from about 15°N almost to the Equator [*7–9*]. Harmattan haze has been analyzed by Hustedt (1921) [*10*] and was found to consist mainly of diatom valves and their fragments. Hustedt gives a list of 51 freshwater diatoms (varieties excluded), mostly common cosmopolitan forms. About half of them (25) were also found in our sediments.

"The places of origin of the 'Harmattan' diatoms are supposed to be the dry, but periodically inundated swamp districts of the Niger and its tributaries. The NE Trade often causes prairie fires and the ashes of burnt plants are one of the components of the 'Harmattan' dust. This could explain the presence of the silicified epidermal cells in the sediments."

It is not known how far diatom valves can be carried out to sea by the wind, but there is reason to believe that they can be carried for very great distances; they settle on the sea, where they are taken up by the currents and carried along until they are finally deposited on the sea floor.

An interesting attempt to explain the presence of fresh-water diatoms in certain Atlantic deep-sea cores has been made by Malaise (*11*). According to this author, parts of the Mid-Atlantic Ridge must have existed as large islands facing the west coast of Africa up to the end of the last Ice Age or later and were submerged in early historical times. These islands gave rise to the Atlantis saga, which Malaise and others consider to have been founded on a reality; Malaise bases his arguments (see, for instance, *12*) on geologic facts and Odhner's (*13*) "constriction hypothesis." According to this explanation, core 234, with its peculiar layer of (exclusively!) fresh-water diatoms, is located in a part of the Mid-Atlantic Ridge which formerly was above sea level, and the corer happened to hit the bottom of a former lake. Malaise considers the finding of this layer to be one of the arguments in support of his theory. Not being a geologist, I do not attempt to discuss the probable validity of Malaise's hypothesis. However, one point is certainly in its favor—the fact that it provides a natural explanation of the layer consisting exclusively of fresh-water diatoms, which is otherwise difficult to comprehend.

To summarize Malaise's hypothesis, the sediments of fresh-water diatoms (at least in core 234) are autochthonous—that is, the diatoms lived at their place of deposition—and had their origin in

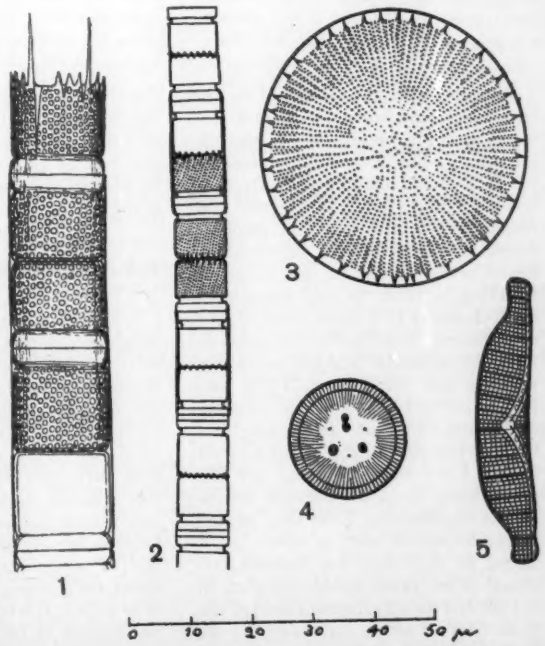

Fig. 2. Some fresh-water forms frequently encountered in Atlantic deep-sea sediments. The species are: (1) *Melosira granulata* (Ehr.) Ralfs; (2) *Melosira ambigua* (Grun.) O. Müll.; (3) *Stephanodiscus astraea* (Ehr.) Grun.; (4) *Cyclotella ocellata* Pant.; (5) *Epithemia zebra* (Ehr.) Ktz. (×1000). [After Hustedt, 1930]

lakes or other fresh-water habitats located in a part, or parts, of a former continent (Atlantis).

We have thus three possible explanations for the presence of fresh-water diatoms in deep-sea sediments of the Atlantic:

Potamic theory. The diatoms originated in African lakes, swamps, and rivers; they were transported by rivers into the Atlantic and were drifted to, and deposited at, the present off-shore localities.

Aeolian theory. The diatoms originated in African lakes, rivers, and swamps. In dry seasons and after the desiccation of these swamps, rivulets, and so on, the fine dust of their bottom mud (often together with ashes of burnt plants) was taken up by the trade winds, blown into the sea ("Harmattan" dust), and finally deposited at the present localities.

Malaise's theory. The diatoms originated in a lake of the hypothetical continent Atlantis or of its remaining islands. The continent sank deep under the present sea level, and the geographic position of the locality of fresh-water diatoms remained unchanged.

All three explanations include a certain element of speculation; future investigations may decide which of them holds true.

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The Challenge to Dentistry

A Tribute to William J. Gies

Theodor Rosebury

William J. Gies, the founder of the International Association for Dental Research and of its *Journal*, died in his 85th year on 20 May 1956. It is my privilege to offer a tribute to his memory. Dr. Gies was primarily a medical educator and researcher. Among his many accomplishments before he became interested in dental problems was the distinction of founding, in 1898, the first department of biochemistry in a medical school. We are primarily interested in his achievements in the dental field—in education, research, and organization. These subjects claimed his energies increasingly during more than half of his long lifetime. Rather than attempt to catalog all he did, I propose to single out just one of his many works to symbolize his influence on dentistry. I am thus leaving biography and obituary to others (*1*). I intend to point out that dentistry, although it has made notable advances in the last few decades, remains short of the goals Gies set for it, particularly in the light of the inevitable comparison of dentistry with medicine. Dentistry, in my opinion, owes William Gies an incalculable debt of gratitude, which we can repay only by carrying forward the work he started. This suggestion is the essence of my tribute.

Bulletin Number Nineteen

It is of his famous *Bulletin Number Nineteen* (*2*) that I wish to write: the survey of dental education in the United States and Canada that Gies made for the Carnegie Foundation for the Advancement of Teaching. Published in 1926, the volume came to my notice a year later—just 30 years ago—while I was a dental student. A fellow-student and I read and studied it with intense interest. We found it then, as I find it now, a monument to the courage, the vision, the learning, and the literary grace of its author. It is incidental that, through my interest in the *Bulletin*, I came to know Gies, to win the Fellowship in Biological Chemistry in his name at Columbia University, and thus to derive from him the personal guidance and inspiration that led me into a career in dental research and teaching.

Since he died I have reread the *Bulletin*. I am struck with its persistent validity and vitality after three decades, and particularly with the light it throws both on our progress in dental education since he wrote it and on our deficiencies, which still remain to be corrected.

I select a few representative details. In the concluding part of the introduction to the *Bulletin* Gies speaks of the primary educational needs of dentistry as he saw them at the time. He asked, for example, for 2 years of college as a predental requirement; for the development of graduate instruction; for better cooperation between dentistry and medicine; for more complete dental libraries; for expansion of dental research; and for the disappearance of independent or proprietary dental schools. He emphasized the need for increased financial support for dental education and called for greater appreciation by dental teachers of the biological and medical side of dentistry. In a later section of the *Bulletin* he suggested that dental disease was being treated too mechanically and empirically because of lack of fundamental knowledge in the field, and that the means for prevention of dental disease were largely lacking, for the same reason.

The author is professor of bacteriology at the School of Dentistry, Washington University, St. Louis, Mo. This article is based on an address that he presented at the 35th General Meeting of the International Association for Dental Research, Atlantic City, N.J., 21 Mar. 1957.

He considered that many dentists at that time practiced superficially, even unprofessionally; that they regarded dentistry as a trade and a business rather than as a profession; and that, for this reason, medicine and dentistry had failed to reach the accord and cooperation required for the highest development of oral health service.

All of us who are old enough to remember the period of the *Bulletin* will be aware of the great progress we have made in these 30 years. Some of Gies' recommendations—a 2-year predental requirement, improved libraries, the disappearance of proprietary schools—have become accomplished facts. In all the other areas there have been advances—notably in research. Yet, though we take pride in our accomplishments, many of us feel, with concern, that some of the deficiencies Gies observed have not been obliterated. We have not reached our goals in medical-dental cooperation, in the development of research-mindedness among dental teachers as a group, and in the need for improved financing of dental education. We are much more biologically and medically minded in dentistry today than we were when I was a dental student, but we remain excessively mechanical in our approach to dental disease.

Dentistry, Medicine, and Science

In many parts of his study Gies compared dentistry with medicine. He had to do so. He needed a measuring rod, and medicine was the most convenient one. I intend to continue the comparison; but let me suggest beforehand that it is not entirely appropriate or fair.

Medicine is a much larger field than dentistry. When we use it as our standard we tend to emphasize its strength, which is the strength of the best of it, and to overlook the weakness that is certainly not lacking in it. The dental profession would not suffer if we could compare it with selected specialties of medicine more equivalent to it in scope. But medical specialties are parts of medicine; they are taught in medical schools and practiced by M.D.'s. Hence, it is less inappropriate to compare dentistry with medicine as a whole than with, say, obstetrics, dermatology, or psychiatry. We cannot avoid comparing schools with schools, one profession with another; but in doing so we must bear in mind that a discount—a discount that we cannot measure precisely—must be applied to the result. Moreover, to compare the change in dentistry with that in medicine during 30 years implies a calculus that involves other unmeasurable variables. This interval has seen a major depression, the greatest war in history, and sweeping postwar changes in human attitudes, objectives, and values. The passage of time has altered all of us, including the observer in this instance—myself. For these reasons I approach the comparison with humility; but it needs to be attempted if we are to judge William Gies' accomplishments.

It seems to me, to put the matter bluntly before I expand on it, that the great strides dental schools have made have been more than matched by even greater strides made by medical schools, so that the gap between dentistry and medicine has grown wider rather than narrower. We seem to be in a position somewhat like that of the Red Queen, who said to Alice, "Now, *here*, you see, it takes all the running *you* can do, to keep in the same place. If you want to get somewhere else, you must run at least twice as fast." We have run fast, but the world of medicine, from which we estimate our position, has moved ahead so much faster that we seem almost to have gone backward. This looks true to me in curious defiance of the fact that the advances in dental schools have occurred precisely in the areas where Gies found them most needed—in improved predental education, in research facilities and personnel, in research itself, and in the growth of full-time faculties, including a far greater proportion than formerly of research-minded teachers. Hence, if what I say is true, we must look to other areas for the reasons for it.

During an interval roughly equivalent to a single long lifetime—the lifetime, in fact, of William J. Gies—and particularly during his last 30 years, medical schools, and indeed the whole of medical practice, have undergone a transformation under the direct influence of experimental science. What seems to me most significant in this transformation is *the idea that disease can be understood and, if understood, controlled.* During this period many diseases have been ameliorated, others have been brought under a large measure of control, and an occasional one has actually been abolished locally—like cholera in the United States. Underlying these developments, the idea that disease is understandable and controllable has come gradually to be accepted, often tacitly, but nevertheless virtually universally. During the modern period this idea has become a foundation for nearly all medical research. As a direct result, medical men—not only researchers but clinicians themselves, in and out of the schools—have become convinced of the importance of science. Science as an attitude and as a method of learning has permeated every branch of medicine, and it is more in consequence of this event than of any other that medical education has reached its present eminence.

I do not wish to suggest that medicine as a practice is any more scientific than dentistry. In a particular sense, in fact, I suggest that neither practice is scientific, and that neither practice would be better if it *were* scientific. The practitioner of either medicine or dentistry needs to understand science, but he does not need to be a scientist. Science is concerned with the acquisition of new knowledge. Practice, to the degree that it leans on science, is concerned with applications. The practitioner's attention is focused on the individual patient, and it is enough if he can see the patient as a whole human being rather than as an isolated organ, cell, or enzyme, a jig-saw puzzle of clinical and laboratory data, a pair of dentures on an elaborate articulator, or a set of drives, tensions, and anxieties impelled by a pair of gonads. Science bears on understanding of all these parts and of the whole man, and even on the idea that the whole man is greater than the sum of his parts. That these contributions of science are essential is a feature of the great transformation in medicine that Gies saw during his lifetime. It is in this sense that medicine has come to accept the spirit of science.

The fact seems to me unavoidable that no comparable transformation has as yet happened in dentistry. Experimental science has grown apace in dental schools. It is taught better than it used to be; it is practiced far more extensively; but, with some noteworthy exceptions, its spirit has not yet caught on among dental students, dental clinical teachers, or dental practitioners as it has among their counterparts in medicine. It is necessary to learn something about science to be a dentist, but it is still possible to forget nearly all of it and yet be a successful practitioner, or even, in some areas, a successful dental teacher.

Conquest of Dental Disease

One must dig deeper at this point for reasons for this state of affairs. I am sure there is more than one reason; but one that seems to me pivotal is the fact that dental research, particularly research in dental schools, despite its great development, has not yet solved any of the problems of dental disease and has indeed contributed little to the everyday practice of dentistry. Fluoridation, of course, is an outstanding exception—a great achievement of dentistry, and by dentistry, for public health. Yet it must be recognized that most of the research that gave us fluoridation did not come from dental schools but came rather from American and Canadian federal, state, and provincial dental public health services. Similarly, the important advances in other areas of dental practice—for instance in nutrition, in pharmacology, in

chemotherapy, in anesthesia, and in many branches of dental technology—have come to us as much, or more, from medical schools and from industrial and government laboratories as from dental schools. Let me emphasize one point: if I seem to be laying blame for our deficiencies on research in our schools I must accept my own share of such blame, since my principal interest from the beginning of my career has been in problems of dental disease. But blame is not my point. It is now abundantly clear that the problems of dental disease are not simple, and I think it can fairly be said that our failure to conquer any of them is no more blameworthy than is equivalent failure in many areas of medicine. But we cannot point, as medicine can, to conspicuous successes that offset our failures, and, as we are a separate profession, our professional development must depend on successful research in our own field.

If, then, we are to follow in the path mapped for us by Gies and achieve for dentistry a status fully equivalent to that of the best specialties of medicine, we ought to set as an avowed goal the conquest of dental disease. In order to do so we must work also for Gies' explicit objectives: for increased medical-dental cooperation, for deeper and wider appreciation of research among dental teachers, and for more money for dental education. I think we can do all these things. Let me digress a little before I suggest what I have in mind.

Experimentation in Dental Education

In a little book that appeared not long ago (*3*), another of my esteemed teachers, A. Leroy Johnson, offered a suggestion that I should like here to reinforce and elaborate upon briefly. He suggested that the Gies *Bulletin* did not have as great an effect on dental education as did the earlier Flexner report on medical education. Medicine, according to Johnson, was more ready for change at the time because it already had an experimental school at Johns Hopkins. Dentistry had nothing of this sort. Following the appearance of *Bulletin Number Nineteen,* and doubtless stimulated in part by it, several experimental schools arose in the dental area, among them the ones at Rochester and at Harvard. It seems to me noteworthy that the Rochester experiment won general esteem from the start whereas that at Harvard, although it finally came to be accepted, was first received, as Johnson points out, in a spirit of controversy and even of hostility. A large part of this difference in the reception of these two projects seems to have depended on the fact that Rochester was never a dental school at all in the usual sense, while Harvard was such, albeit of a new sort. Harvard therefore seems to have been a challenge to intrenched notions, whereas Rochester was not.

This is not the place to offer a justification of the Harvard experiment *per se*. What I do wish to justify is the general principle of experimentation in dental education. It seems to me essential for the advancement of dentistry that we encourage more and more research, not only on particular problems of dental health and disease but in the broad area of dental education itself. The time is ripe for such experimentation. The need for more dental schools is clear and is slowly being met (*4*). I suggest that some of these new ones should be (and even that some of our old ones should become) frankly experimental, and that they should be encouraged and supported as frank experiments. It must be remembered that here, as elsewhere, experimentation is uncertain in outcome; a proportion of failure must be allowed. As Claude Bernard (*5*) put it, "We are all likely to make mistakes, except those of us who do nothing." The same idea is expressed by van Niel (*6*), who, considering the apparent wastefulness of mutation as an evolutionary mechanism, suggests "that the development of something new, even in human endeavor, is generally the outcome of efforts many of which yield only negative results."

And so I wish to suggest that at least two things be done to forward the status of dentistry, consistently with the objectives set down by William Gies. The first is to broaden our horizon as experimenters to include dental education itself: to develop new schools, and to change old ones, in order to improve medical-dental cooperation and to encourage a spread of the spirit of science into all parts of the school. Let us look ahead to the time when the practice of dentistry will have become infused with the spirit of science and begin now to build schools accordingly. Together with such undertakings, better financing must be achieved, and with this sort of purpose I think it can be.

As part of such efforts I suggest, in addition, that an attempt be made to apply a dearly learned lesson of the late war. Side by side with individual research, in which the qualified investigator is left free to roam as he pleases, there is a place for the cooperative or group approach. Here a number of partners drawn from different disciplines work together to solve a particular problem. This teamwork approach was highly developed by the British in the early years of the war in the application of science to the study of military operations. It has since come to be used widely in industry and in many areas of medicine in the effort to solve problems of both basic and applied science. Dentistry has not taken full advantage of its potentialities. Such a group works best with only nominal leadership, as a string quartet plays under the subtle guidance of the first violin. I can testify from personal wartime experience not only that this cooperative method is effective but that it can be an exhilarating experience for the individual researcher. It might be a way of getting at the roots of our problems of dental disease.

To do these things will require vision, courage, imagination — qualities that stand forth in the William J. Gies of *Bulletin Number Nineteen*. I do not suggest that my ideas about how they might be done are the only feasible ones but only that the job needs doing, and that the doing of it would embody the noblest tribute we could offer to Gies' memory. Let us try to move closer to the goal he set for himself and for all of us.

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News of Science

Sex Determination

After a quarter-century since the Russian biologist V. N. Shreder first reported that male-determining and female-determining spermatozoa of the rabbit could be separated by electrophoresis, a vexatious period marked by conflicting reports, M. J. Gordon of the University of California appears to have finally settled the question [*Proc. Natl. Acad. Sci. U.S.* (October 1957)]. In 31 litters produced after artificial insemination either with sperm that traveled to the cathode or with sperm that traveled to the anode, the former produced 51 males as against 29 females, the latter 62 females as against 25 males. A difference of such magnitude would be expected to occur by chance in less than one trial per thousand.

The spermatozoa can be observed migrating tailfirst toward the anode or the cathode, and when the polarity of the electrodes is changed, they mutually reverse their direction of travel. Human spermatozoa have likewise been observed previously to migrate tailfirst in an electric field. Although the success in producing males at will was only 63.7 percent and in producing females at will only 71.3 percent, the techniques of separation and insemination are being improved and may eventually lead to a high degree of control over sex determination. The obvious problems that are likely to arise if successful control of human sex determination becomes practicable as a result of such experiments make one wonder whether human beings have yet acquired the wisdom to make use of such wide powers.—B.G.

Who Can Aid Visiting Geneticists?

A number of geneticists from abroad will be coming to the International Genetics Congress in Montreal, 20–27 August 1958. Undoubtedly, some of them can come before the congress and some can stay after the congress. Undoubtedly, also, some would like to visit laboratories in the United States, but to do so they will need dollars.

The Travel Assistance Committee for the congress is anxious to know which laboratories would like to help foreign geneticists by inviting one or more either to give a lecture or to come as a consultant on research. Institutions with funds available for such lectures or consultations should communicate as soon as possible, preferably *before 1 December,* with Harriet B. Creighton, Department of Botany and Bacteriology, Wellesley College, Wellesley 80, Mass.

Science Talent Search

High school seniors throughout the country are competing for awards and scholarships totaling $34,250 in the 17th annual Westinghouse Science Talent Search. Because of an expanded grant recently announced by the Westinghouse Educational Foundation, the amount to be awarded to the winners this year will be more than three times larger than the $11,000 distributed each year in the past.

The search is administered by Science Service. Last year more than 20,000 students entered the contest. From the thousands of applicants, the judges select 40 national winners, who then attend the 5-day Science Talent Institute in Washington, D.C., and compete for the top five scholarships. The entire trip is free of expense to the 40 students.

Cadaver Shortage

A six-part program has been proposed by a committee of the National Society for Medical Research to relieve the increasingly serious shortage of cadavers, a shortage that threatens the quality of medical education in the United States. Oliver P. Jones, head of the anatomy department at University of Buffalo Medical School, and chairman of the committee, says that a majority of medical colleges report that they are unable to obtain enough bodies to teach efficiently, and that some schools have been forced to drop such important courses as surgical anatomy.

The committee's proposed program suggests: (i) a survey of public opinion toward anatomical studies; (ii) a series of conferences with religious leaders, public welfare administrators, undertakers, hospital superintendents, and other persons concerned with the disposition of bodies; (iii) a program of education for persons in the health professions; (iv) a general public educational program; (v) the drafting of modern laws making bodies available through bequest (in 39 states, a person's body is not his own to give after death); and (vi) the establishment of a legal reference service, with standardized forms and procedures for bequeathing a body to a medical school. In the opinion survey, a depth-interview study that will discover underlying sentiments has been proposed. Results of the study will provide a foundation for the other five elements of the program.

The University of Buffalo alone operated its anatomy department last year 23 cadavers short of the number necessary for adequate instruction. It was not able to give anatomical instruction to nurses and people in the public health fields. The department used 37 bodies to instruct 68 dental and 80 medical students. This meant four students to each body—and soon a larger number of students will have to be assigned.

U.S.–U.S.S.R. Populations

The populations of both the United States and the Soviet Union are apparently growing at a steady rather than an explosive rate, with the U.S.S.R. expected to retain its present lead, according to a recent report by the Population Reference Bureau, Washington, D.C. The bureau stressed the word "apparently" in connection with Russian population figures, since no one knows for sure how many Soviet citizens there are. For this reason there will be great interest in the Soviet census that is scheduled to begin in January 1959.

The last time complete census figures were published was in 1926, 31 years ago. In 1937, the Stalin regime denounced and abrogated the census results and ordered another census. Only scattered findings from this census were disclosed in 1939. Based on an official Soviet estimate recently released to the United Nations, the U.S.S.R. population of today is around 205 million; the U.S. population is about 172 million.

The bureau's analysis of available information indicates that the Russian birth rate now stands just about at the same level as the United States birth rate. A generation ago, birth rate trends in the U.S.S.R. and the United States were in opposite directions. In 1926, the Russian birth rate stood at 44 per 1000; it had declined to 33 by 1940; and it fell

to 26.5 in 1950. The United States birth rate was 24.2 per 1000 in 1926; fell to 19.4 by 1940; rose to 26.0 in 1947; and since 1950 has stabilized at around 25.

From 1950 through 1955, the rate of natural increase—the difference between the birth rate and the death rate—has been slightly higher for the U.S.S.R. than for the United States. In 1955 it was 1.7 in the U.S.S.R. and 1.6 in the United States.

The annual rate of increase in the U.S.S.R. is high compared with that in most of the countries to the west (France, 0.6 percent; Sweden, 0.5 percent; West Germany, 0.5 percent; United Kingdom, 0.4 percent). It is much lower than the rate in many underdeveloped countries, where the death rate has recently declined rapidly and birth rates have remained high. (The following countries have annual increases of approximately 3 percent a year: Ceylon, Egypt, Malaya, Algeria, and Mexico.)

The bureau's comparison of the two nations' death rates shows fairly parallel downward trends in the postwar years due to medical advances. That Russia's death rate of 8.4 in 1955 was lower than that of the United States (9.3) can be attributed to the relatively younger population of the Soviet Union. The Soviet's total population estimate of 200.2 million as of 1 April 1956 came as a surprise to western demographers, who had estimated the Russian population was considerably higher (216 million).

Soviet Metallurgy

The board of governors of Acta Metallurgica, the national organization which publishes the first technical magazine devoted exclusively to the science of metallury, has announced that beginning in January 1958 it will publish English-language editions of two Russian journals on metallurgy. A contract has been signed by Acta Metallurgica with the Pergamon Institute, a nonprofit foundation for the dissemination of scientific literature, to publish English editions of *The Physics of Metals and Metallurgy* and *The Journal of Abstracts—Metallurgy.*

A recent grant of $23,710 was received by Acta Metallurgica from the National Science Foundation to help defray the cost of preparing the English-language editions of the Soviet journals. Copies of the translations will be made available to technical libraries throughout the western world and to members of the 22 technical societies which participate in Acta Metallurgica. The first editions will be translations of the January 1957 issues of both Russian publications. It is estimated that the English editions of the two monthly publications will total approximately 1500 pages per year.

Radiation Effects Information Center

The Radiation Effects Information Center has been established by the Air Force at Battelle Memorial Institute, Columbus, Ohio, to gather and disseminate data concerning the effects of nuclear radiation on materials and systems that may be required in aircraft of the future. While the center has been organized to support the Air Force's nuclear-propelled aircraft program, its services are being extended to the Army, Navy, Atomic Energy Commission, and other Government agencies, as directed by the Air Force.

Initially, Battelle has assigned a 20-man team of specialists to the new unit. Coordinator of the center is Battelle's C. B. Voldrich, with Robert I. Leininger and Carl J. Lyons serving as assistants. Gilbert F. Arthur of Wright Air Development Center is the task engineer.

Color TV to Teach Mathematics

The first experimental use of color television to teach an academic subject was announced recently by the Advisory Board of Education of the National Academy of Sciences. Using the new closed-circuit color TV facility at Walter Reed Army Medical Center, the University of Maryland is offering 26 lectures on the concepts of calculus to a group of in-service high-school teachers of mathematics and science in the Washington, D.C., area.

The experimental value of the course has been greatly aided by a supporting grant from the Fund for the Advancement of Education of the Ford Foundation. The grant will enable the NAS to introduce a second innovation in audio-visual aids to teaching—color kinescopes of the televised lectures. These color kinescopes provide an opportunity for comparison of various techniques and are essential to evaluation of the experiment. They will later be made available to other suitably equipped institutions for further evaluation tests with student audiences.

Analgesic Drug Awards

The Institute for the Study of Analgesic and Sedative Drugs has announced that applications by research investigators for support of projects to be developed during the fiscal year beginning 1 July 1958 are now being considered. The institute is a nonprofit organization established for the purpose of obtaining basic biological and clinical information on the commonly used non-narcotic analgesic and sedative drugs, including aspirin, acetanilid, acetophenetidin, antipyrine, aminopyrine, N-acetyl p-aminophenol, and the bromides.

The deadline for the filing of applications by prospective research investigators is *28 February 1958.* Information concerning grants and applications for grants may be obtained by writing to The Institute for the Study of Analgesic and Sedative Drugs, Myrtle and McNaughton Streets, Elkhart, Ind.

The African Bushman

The Peabody Museum of Harvard University and the Smithsonian Institution are sponsoring a 6-month expedition to the Kalahari Desert in Africa. The expedition, which is expected to reach its destination sometime this month, will be the last of six visits to study the Bushmen, a small race of people who are an ethnic island in the middle of southern Africa. They live on a sparse basin plateau. They have no husbandry or agriculture but depend instead on hunting and gathering for their food supply.

The recording of native life on film and sound tape was initiated by the first expedition to these remote people, and continued by the other four. Approximately 250,000 feet of film has already been used, and this final expedition is expected to bring the work to a close. In addition, hundreds of reels of tape recordings of music and language have been made.

Eventually the study of the Bushmen will be contained in 25 documentary films. While there have been other films of primitive peoples and cultures, this will be the first time that a definitive work has been done entirely in this medium. The present expedition will fill in gaps in the material now at the Peabody Museum.

The Bushmen are a group distinct from the Bantus, who live all around them. They are short in stature, with extremely curly "pepper corn" hair. Their skin, while dark, has red hues not found among other African peoples. Their language and religion are also distinctive.

They live in small tribal groups of 30 to 100 persons, with a simple family and political organization. The ablest hunter often has the role of leader, though this is thought to be as much a chore as an honor.

The Bushmen have had almost no contact with the outside world. When the first Harvard-Smithsonian expedition arrived, most of the Bushmen saw

white men for the first time. Except for two diamond prospectors who briefly visited the Kalahari Desert some years ago, the Bushmen have not seen any other white people in their territory. However, the Bushmen have recently had increasing contact with Bantus, and it is feared that the distinctiveness of Bushman culture will soon be lost. The current expedition is headed by Laurence K. Marshall of Cambridge, Mass., who led the previous five visits to the Kalahari Desert.

Harvard-Guggenheim Center for Aviation Health and Safety

Thirteen military and civilian doctors and engineers are registered in the first postgraduate study program in the Harvard-Guggenheim Center for Aviation Health and Safety now underway at Harvard University's School of Public Health in Boston. The center, the fifth and newest aviation research center established in the United States by the Daniel and Florence Guggenheim Foundation, is under the technical direction of Ross A. McFarland, associate professor of industrial hygiene at Harvard. This is the first center set up by the foundation to deal directly with aviation health and safety. Support of the program is through a $250,000 grant, extending over a 5-year period.

At the new center, attention is focused on the unification of basic research involving studies of human problems in the era of jet aircraft; advanced training for physicians, biological scientists, and aeronautical engineers in problems involving aviation health and safety; and establishing a clearing house for technical information on aviation health and safety. The center is utilizing the interdisciplinary or team approach in its instruction program. This effectively coordinates the work of such diverse specialists as engineers, physicians, psychologists, physiologists, and anthropologists. Most of the departments in the School of Public Health, and specialists elsewhere in Harvard University, are participating in the instruction.

News Briefs

The new headquarters building of the Atomic Energy Commission near Germantown, Md., was dedicated on 8 November. The commission's Washington staff is expected to move to the new location in the first half of January.

* * *

Heini Hediger, European animal behaviorist and director of the zoo in Zurich, Switzerland, has opened what he calls a "museum of human imbecility" in relation to caged animals. It consists of a collection of objects, including many sharp weapons, found in cages or taken from zoo visitors.

* * *

On 4 December, in the second trans-Atlantic medical conference in history, scientists in the United States and Great Britain will exchange research information on cancer chemotherapy over the new undersea cable. The conference will last 1¼ hours. Three world medical centers will be linked: Philadelphia, where the American Medical Association will be convened in its 11th annual Clinical Meeting; London, where a special panel will meet in Barnes Hall of the Royal Society of Medicine; and Bethesda, Md., where the program will be heard at the National Institutes of Health. The conference will be sponsored by the AMA and the Royal Society of Medicine in cooperation with Smith, Kline & French Laboratories.

* * *

A building housing pharmacy research and development laboratories was dedicated by CIBA Pharmaceutical Products, Inc., at Summit, N.J., on 21 November. The new structure contains 18 research laboratories and 27 additional special-purpose rooms. The laboratories are headed by Jack Cooper, director of the Pharmacy Research and Development Division.

* * *

On 4 November President James B. Killian of Massachusetts Institute of Technology and President Nathan M. Pusey of Harvard University broke ground for the Cambridge Electron Accelerator. The two institutions are cooperating in the design and operation of the new $6-million machine, which is expected to go into operation in January 1960.

* * *

Former President Herbert C. Hoover and Detlev W. Bronk, president of the National Academy of Sciences, will be the principal speakers on 1 December when bronze busts of George Westinghouse and Josiah Willard Gibbs are unveiled at the Hall of Fame for Great Americans at New York University. Westinghouse invented the air brake and many electrical devices. Gibbs, a mathematical physicist and professor at Yale University, formulated the theory of thermodynamics, the basis for much of modern physical chemistry and chemical engineering.

* * *

The Council of the Oak Ridge Institute of Nuclear Studies announced at its 13th annual meeting that West Virginia University had joined the institute as a sponsoring university. The admission of West Virginia brings the total of ORINS sponsors to 36.

Scientists in the News

J. ROBERT OPPENHEIMER, internationally known nuclear physicist and director of the Institute for Advanced Study, Princeton, N.J., has been awarded the French Legion of Honor, France's highest civilian award.

BURTON W. ADKINSON, director of the Reference Department of the Library of Congress, has succeeded the late Alberto F. Thomson as head of the Office of Scientific Information at the National Science Foundation.

WILLIAM K. LIVINGSTON, head of the department of surgery at the University of Oregon Medical School, will retire on 1 January. He will remain on the surgery staff on a part-time basis with the rank of professor, and he will continue his research on the causes of pain. Livingston received his medical degree from Harvard University in 1920. He practiced in Eugene and Portland, Ore., and served in both world wars—attaining the rank of captain in the U.S. Navy medical corps reserve at the time of his discharge in 1946. A year later, he assumed the Kenneth A. J. Mackenzie chair of surgery at the Oregon Medical School. In that same year he was chosen to give the Lord Moynihan Lecture at the Royal College of Surgeons, London. Livingston is the author of two medical books, *The Clinical Aspects of Visceral Neurology*, published in 1937, and *Pain Mechanisms*, published in 1947.

THOMAS K. PAVLYCHENKO, formerly research professor and head of the department of plant ecology at the University of Saskatchewan, Saskatoon, Canada, and at present director of agricultural research for the American Chemical Paint Company, Ambler, Pa., was honored for his research achievements on the occasion of his 65th birthday, 20 October, in Saskatoon. Pavlychenko developed a method for quantitative studies of the root systems of plants grown under natural field conditions. He found that a single grass plant (*Agropyron cristatum*) grown for two seasons without competition, produced 319.5 miles of root fibres, thus binding the loose soil to resist erosion forces and to compete with weeds.

WARREN K. LEWIS, professor emeritus of chemical engineering at Massachusetts Institute of Technology, received the American Petroleum Institute's Gold Medal for Distinguished Achievement during the institute's recent annual meeting in Chicago. Lewis is known for his work in fractionation in refining, in solvent recovery systems, and in vacuum distillation of lubricating oils.

FREDERICK N. RHINES, professor of light metals at Carnegie Institute of Technology, received the Henry Marion Howe Medal during the recent American Society for Metals' 39th National Metals Exposition and Congress in Chicago. This award is given annually for the best paper published in the society's Transactions. Rhine was honored for an article on "Grain Boundary Creep in Aluminum Bicrystals," which he wrote jointly with W. E. Bond and M. A. Kissel.

Leaders of industry and alumni and faculty of Cornell University recently held a recognition dinner to honor FRED RHODES, who retired from Cornell in June as professor emeritus of chemical engineering. He was the founder and first director of the School of Chemical Engineering at Cornell. During the dinner Rhodes was presented with a symbolic gift representing $350,000 which is being raised to endow the Rhodes chair of chemical engineering at Cornell.

JOHN C. BUGHER, director of medical education and public health at the Rockefeller Foundation in New York, will present the second annual Carl V. Weller Lecture at 5 P.M. on 14 December in the University of Michigan's Horace H. Rackham Amphitheater. Bugher's topic will be "The Role of the Pathologist in Medicine." Sponsored by the Michigan Pathological Society, the annual Weller lectures were originated in 1956 in honor of the University of Michigan pathologist who was chairman of the department of pathology for 30 years.

HUGO BENIOFF, professor of seismology at the California Institute of Technology, has received the Arthur L. Day Medal of the Geological Society of America in recognition of outstanding contributions to geologic knowledge through the application of physics and chemistry to solution of geologic problems.

MOREAU S. MAXWELL, who has been chief of the arctic branch at the Arctic, Desert, Tropic Information Center, Maxwell Air Force Base, and who formerly taught anthropology at Beloit College, has been named curator of anthropology at the Michigan State University Museum and associate professor in the university's department of sociology and anthropology. One of his duties will be to develop further a graduate research program in archeology.

EDWIN DIAMOND, formerly science writer for International News Service, has been named science editor of *News Week*.

WENDELL A. HORNING, formerly head of reactor theory at the Ramo–Wooldridge Corporation, Los Angeles, Calif., has joined Atomics International, a division of North American Aviation, Inc., as group leader of theoretical neutron physics.

IRA D. CLARKE has retired from the U.S. Department of Agriculture after 40 years of service as a research chemist. He is a specialist in hides and skins, tanning materials, and leather. Clarke graduated from Butler University in 1912. After a brief career as a high-school teacher in Oklahoma and as assistant chemist at Iowa State College, he became a chemist for the USDA's Bureau of Chemistry in Washington in 1917. In 1941 he transferred to the new Eastern Regional Research Laboratory in Wyndmoor, Pa., where he has been since that time.

EUGENE P. WIGNER, Thomas D. Jones professor of mathematical physics at Princeton University, has begun a 2-month residency as visiting professor in the Enrico Fermi Institute for Nuclear Studies at the University of Chicago.

J. F. DOWNIE SMITH, dean of engineering at Iowa State College for the past 10 years, has been named a vice president of the Carrier Corporation and head of its Central Research and Development Division, effective 1 January 1958.

MAHGUL MOHAMAD ALI of Kabul, Afghanistan, graduate of La Fatima Jinnah Medical College in Lahore, Pakistan, and the first Afghan woman doctor, has been enrolled as a special student at the Woman's Medical College of Pennsylvania.

HAROLD ST. JOHN, first holder of the Wilder chair in botany at the University of Hawaii, has been elected an honorary member of the Botanical Society of Japan. Election to the honor was conferred at the Diamond Jubilee celebration of the society, in Tokyo, 12–15 October.

THEODORE H. INGALLS, associate professor of epidemiology at the Harvard University School of Public Health, has been appointed professor of preventive medicine and epidemiology at the University of Pennsylvania, effective July 1958. At Pennsylvania, he will carry on a long-term study of methods for the early detection of chronic diseases, an activity supported by a 5-year grant from the W. K. Kellogg Foundation. In addition, he will develop projects for evaluating radiation hazards and for the control of congenital defects.

Recent Deaths

JESSE O. ARNOLD, Philadelphia, Pa.; 89; professor emeritus of obstetrics at Temple University Medical School; 3 November.

CHARLES BAGLEY, JR., Baltimore, Md.; 75; professor emeritus of neurosurgery at the University of Maryland Medical School; 2 November.

HOMER W. CLOUGH, Richmond Hill, N.Y.; 88; retired meteorologist who served the U.S. Weather Bureau from 1893 to 1928; author of statistical analyses of meteorological and solar data; 27 October.

R. FINLEY GAYLE, JR., Richmond, Va.; 65; psychiatrist and head of the psychiatric department at the Medical College of Virginia; past president of the American Psychiatric Association; author of many articles on psychiatry; 4 November.

HERBERT F. GERALD, Lake Zurich, Ill.; 76; professor emeritus of physiology and pharmacology at Creighton University and former chairman of the department; had been associated with the university since 1912; 18 October.

RICHARD C. HUBLEY, Fairbanks, Alaska; 31; geologist; coordinator of all United States glacial research in the Northern Hemisphere as part of the International Geophysical Year; 28 November.

EDWARD J. KEEGAN, Floral Park, N.Y.; 56; chairman of the biology department at St. John's University; 27 November.

B. K. NORTHROP, Ithaca, N.Y.; 64; professor of electrical engineering at Cornell University since 1929; 25 October.

THOMAS ROBINS, Stamford, Conn.; 89; inventor; founder and former chairman of the board of the Hewitt–Robins Company, Stamford, Conn.; the conveyor belt he devised and later perfected for Thomas A. Edison is used by industry in most countries throughout the world; 4 November.

C. W. SCHWARTZ, White Plains, N.Y.; 66; retired physician and radiologist and former associate professor of radiology at the College of Physicians and Surgeons of Columbia University; 30 October.

G. ALEXANDER YOUNG, Omaha, Neb.; 81; former head of the department of neuropsychiatry at Creighton University and the University of Nebraska; pioneered in the use of insulin in the Midwest for treatment of mental illness; 3 November.

Erratum: The value of the ratio of "apparent" retention volumes $(V'_R)_H/(V'_R)_D$, given in paragraph 2, sentence 3 of the report, "Isotope Effects in Gas-Liquid Chromatography," by K. E. Wilybach and P. Riesz [*Science* 126, 748 (18 October 1957)], should have been 1.08 ± 0.01 instead of 1.80 ± 0.01.

Reports

On the Physiologic Significance of Monoamine Oxidase in Brain

The discovery of norepinephrine in brain is creating considerable interest concerning the role of this neurohumoral agent in the central nervous system (*1*). Its precise function is still unknown, but the similar patterns of distribution of bound norepinephrine and serotonin, particularly the high levels in the hypothalamus, permit speculation that both amines act in central regulatory mechanisms.

If norepinephrine in brain acts as a chemical transmitter, there must be a mechanism to prevent accumulation of the free substance at receptor sites. The mode of inactivation of norepinephrine released from storage in brain becomes therefore of obvious importance. Several enzymes can metabolize norepinephrine and epinephrine *in vitro* (*2*), but the extent to which each participates *in vivo* is controversial. Monoamine oxidase has been considered in many reports, but a number of objections have been raised against the view that this enzyme is functionally significant in destroying norepinephrine that is released from adrenergic nerves. Perhaps the most important objection is the relatively slow action of this enzyme on catechol amines *in vitro*; in fact, its more rapid action on serotonin has suggested to some workers that this indole may be the only important physiological substrate (*3*). But we may well ask whether the properties of the enzyme in a homogenate can be translated into a clear picture of its action *in vivo*. If brain monoamine oxidase is concentrated at adrenergic nerve endings, as is reported for the enzyme in sweat glands of the horse (*4*), it could almost instantly destroy minute amounts of hormone that are liberated at receptor sites, regardless of the relatively low activity of the enzyme after dilution in tissue homogenates.

Conclusions concerning the physiologic importance of monoamine oxidase are also questionable when they are based on studies of the metabolism of injected norepinephrine. The fate of norepinephrine, when administered intravenously, could be quite different from its fate when it is released from nerves in close proximity to a high concentration of monoamine oxidase. Thus injected norepinephrine might contact enzyme systems not present in adrenergic nerves and yield products not representative of the metabolic fate of amine released from nerves.

The present report describes experiments which implicate monoamine oxidase as the enzyme mainly responsible for the physiologic inactivation of both serotonin and norepinephrine in brain. In these experiments the amines were measured by specific fluorometric procedures which assay total (bound plus free) amines (*5*). Their degradation was assumed to be catalyzed by monoamine oxidase if blocked by known monoamine oxidase inhibitors.

The rates of metabolism of the amines were measured in homogenates of rabbit brain stem prepared in 6.5 volumes of 0.1*M* phosphate buffer at *p*H 7.4. Norepinephrine or serotonin was added to yield a concentration of 10 μg/ml, and the preparations were incubated in air at 37°C. Under these conditions, about half the serotonin disappeared in 10 minutes as compared with 50 minutes for norepinephrine (*6*). The metabolism of the amines was almost completely suppressed by the monoamine oxidase inhibitors, iproniazid (10^{-3} to $10^{-4}M$) and ephedrine ($10^{-2}M$). These results led to the conclusion that both amines were destroyed in the homogenates by the action of monoamine oxidase only.

The importance of brain monoamine oxidase *in vivo* was demonstrated by the substantial rise in levels of the amines in brain stem after administration of iproniazid. When iproniazid was given subcutaneously to four rabbits in doses of 50 mg/kg for 4 days, the levels of serotonin in brain stem increased from about 0.7 to 1.5 μg/g and those of norepinephrine from about 0.5 to 1.5 μg/g.

Destruction of the amines at their actual sites of release in brain was studied through the action of reserpine in freeing both norepinephrine and serotonin from their storage depots (*7*). After administration of reserpine to rabbits, brain levels of the amines declined as they were released and enzymatically destroyed (Fig. 1). However, pretreatment of the animals with iproniazid completely blocked the metabolism of the released amines (Table 1), suggesting that they were acted on by monoamine oxidase only. It could be argued that iproniazid prevented the release of the amines by reserpine, but earlier studies have indicated that iproniazid does not affect the liberation of serotonin from brain (*8*) or platelets (*9*).

It is noteworthy, however, that after administration of reserpine, norepinephrine and serotonin disappeared from brain at identical rates (Fig. 1), in marked contrast to the dissimilar rates in brain homogenates. This suggests that the rates of metabolism of the amines, after administration of reserpine, were limited not by the action of monoamine oxidase, but rather by the time required for the substances to be released and to contact the enzyme. This would be in accord with an earlier finding that considerable time is required for reserpine to free all the serotonin from platelets *in vitro* (*10*). It would thus follow that the actual rates of destruction of the amines at sites of their release in brain would be rapid in order to cancel out the preference of monoamine oxidase for serotonin as observed *in vitro*. This would hold true if the concentration of monoamine oxidase were very high at nerve endings.

The data presented here show that iproniazid, a potent inhibitor of monoamine oxidase (*11*), blocks the metabolism of brain norepinephrine and serotonin *in vitro* and *in vivo*, suggesting that monoamine oxidase in brain has a major role in the physiologic inactivation of

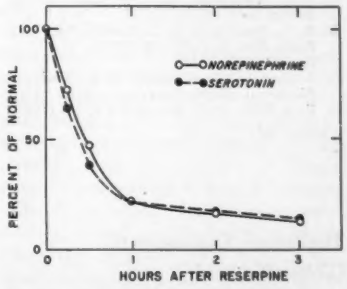

Fig. 1. Comparative rates of disappearance of norepinephrine and serotonin in rabbit brain stem after release by intravenous administration of reserpine (5 mg/kg). Points at zero time denote amine concentration in controls (norepinephrine, .0.5 μg/g; serotonin, 0.7 μg/g). Each value represents the average of from 2 to 4 animals.

All technical papers and comments on them are published in this section. Manuscripts should be typed double-spaced and be submitted in duplicate. In length, they should be limited to the equivalent of 1200 words; this includes the space occupied by illustrative or tabular material, references and notes, and the author(s)' name(s) and affiliation(s). Illustrative material should be limited to one table *or* one figure. All explanatory notes, including acknowledgments and authorization for publication, and literature references are to be numbered consecutively, keyed into the text proper, and placed at the end of the article under the heading "References and Notes." For fuller details see "Suggestions to Contributors" in *Science* 125, 16 (4 Jan. 1957).

Table 1. Effect of iproniazid on metabolism of brain serotonin and norepinephrine after release by reserpine. The rabbits received 100 mg/kg of iproniazid intravenously. After 6 hours some animals received 5 mg/kg of reserpine intravenously. One hour later the animals were killed and their brain stems were analyzed. Values for amines in animals given iproniazid are somewhat higher than normal because the inhibition of monoamine oxidase causes levels to rise.

Injection	Serotonin level (μg/g)	Norepinephrine level (μg/g)
Iproniazid	1.00, 1.46	0.69, 0.61
Iproniazid + Reserpine	1.15, 1.08	0.64, 0.67, 0.57

both amines. Since iproniazid blocks the deamination of brain norepinephrine without disclosing another metabolic pathway, it seems unlikely that appreciable amounts of the "hallucinogenic" adrenochrome type of compound are formed in normal brain.

PARKHURST A. SHORE, J. A. R. MEAD, RONALD G. KUNTZMAN, S. SPECTOR, BERNARD B. BRODIE
Laboratory of Chemical Pharmacology, National Heart Institute, Bethesda, Maryland

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5 August 1957

Toxicologic Evaluation of Gibberellic Acid

Gibberellic acid, a metabolic product of the fungus *Gibberella fujikuroi*, produces a diversity of responses in plants, perhaps the most striking of which is rapid elongation of shoots or acceleration of the rate of organ growth. Horticulturists and agronomists are currently making application of this agent to many economic and ornamental plants with the expectation of usefully modifying the normal growth habit (*1*). The agent is produced in practical quantities from filtrates of deep cultures of the fungus (*2*). Phinney (*3*) has reported that "Gibberellin-like" materials are present also in extracts of flowering plants, thereby indicating that these agents are natural constituents.

Plants are treated with the potassium salt of gibberellic acid (*4*), by spraying (concentrations of 1 μg to 1.0 mg/ml), by painting with a paste (0.5 to 1.0 percent), or by dipping seeds in solutions of 1.0 percent, or lower, concentrations. Thus concentrations of the agent which may be accidentally inhaled or ingested, or which may come into contact with the eye or skin, vary greatly. The residue remaining on treated plants at the time of harvesting appears to be negligible. Presently available analytical methods (sensitive to less than 1 μg/ml) are unable to detect the agent in harvested plants. Toxicologic studies of gibberellic acid, designed to expose any inherent toxicity for the human being or animal, are presented in this report.

Gibberellic acid was prepared either as a 30.0 percent aqueous solution by converting the acid to the sodium salt with sodium hydroxide or as a 50.0 percent concentration in carboxymethylcellulose suspension. For determinations of the acute intravenous toxicity, the appropriate concentrations were administered into the tail veins of Carworth female white mice in volumes of 0.5 ml or less at the rate of 1.0 ml/min. For determinations of acute oral toxicity, the appropriate concentrations were administered by stomach tube. The mice were observed frequently for several hours and then were held for 7 days, when some of the surviving mice were sacrificed; various tissues (*5*) were then examined grossly and prepared for histomorphologic studies.

Studies of the acute intravenous toxicity of gibberellic acid gave an LD_0 of 4.2 g/kg, and LD_{50} of 6.3 g/kg, and an LD_{100} of 8.7 g/kg. The signs of toxicity were nonspecific. No deaths and only minimal signs of toxicity were observed after the oral administration of 25.0 g/kg. Gross and histomorphologic studies did not reveal lesions or tissue changes that could be attributed to an effect of administration of gibberellic acid.

Twenty-seven male and 27 female Holtzman white rats were fed a diet containing 5.0 percent gibberellic acid. One-third of these animals were sacrificed after 5 weeks' feeding on the diet, and one-third after 8 weeks' feeding. The remaining rats are being continued on the diet. Three groups of control rats were fed the basal diet, and one group was sacrificed with each experimental group.

Body weights, food consumption, and hematologic values were normal for all groups of rats. Gross and histomorphologic studies of the various tissues (*5*) did not reveal lesions or alterations that could be attributed to the administration of gibberellic acid. Weights of organs were within normal limits.

Two groups of male and female Holtzman rats were exposed to an aerosol produced by spraying a solution containing 200 or 400 parts per million of gibberellic acid. The aerosol was produced continually for 10 minutes in a closed 88-1 chamber containing one group of rats. The rats then were held in the chamber for an additional 50 minutes. This procedure was repeated twice a day for 3 weeks. One-half of the rats were sacrificed at the termination of the study, one-fourth of the original group were autopsied after 1 month, and the remaining rats 2 months after the exposure. Control rats were exposed to an aerosol of the vehicle and sacrificed in the same temporal sequence. Gross and microscopic examinations of the various tissues (*5*) did not reveal abnormalities.

A single application of a 1.0 percent aqueous suspension of gibberellic acid to the eye of the rabbit did not produce immediate or delayed signs of irritation.

A concentration of 100 μg/ml in cultures of Rhesus testicular cells, Hela cells, or stable human amnion cells did not result in toxic reactions or in stimulation of cell growth. Repeated subcultures through several passages in the presence of the agent did not reveal cytotoxic activity. The yield and morphology of the cells were not influenced.

The order of acute and subacute toxicity of gibberellic acid is such that it is relatively harmless when administered orally, parenterally, by inhalation, or by topical application. This is the more remarkable since the agent is so potent that it may be employed effectively in amounts that leave no detectable residue on plants. The present evidence indicates that the agent presents no apparent hazard either to the individual who uses the material for agricultural purposes or to the individual who consumes products on which gibberellic acid or salts have been used.

HAROLD M. PECK, SAMUEL E. MCKINNEY, ALFRED TYTELL, BRUCE B. BYHAM
Merck Institute for Therapeutic Research, Merck, Sharp & Dohme Research Laboratories, West Point, Pennsylvania

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54, 240 (1955); F. H. Stodola, G. E. N. Nelson, D. J. Spence, *ibid.* 66, 438 (1957).
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4. Gibrel is the name applied to the potassium salt of gibberellic acid by Merck & Co., Inc. The gibberellic acid used in these studies was prepared by the Chemical Division, Merck & Co., Inc., Rahway, N.J.
5. The tissues examined included skin, skeletal muscle, gonads and accessory sex organs, stomach, intestine, salivary glands, thymus, pancreas, adrenal, thyroid, parathyroid, lymph nodes, spleen, liver, kidney, urinary bladder, aorta, heart, lung, bone marrow, and usually the pituitary, brain, and spinal cord.

5 August 1957

Preparation of Cell-free Yeast Homogenate That Converts Acetate to Sterols

Cell-free yeast preparations have been applied recently to the study of sterol biogenesis (*1*). However, all these preparations require complicated apparatus for the mechanical disruption of yeast cells. A search for an easier method has been conducted in this laboratory over the last 2 years, and a method employing only the simplest equipment is described in this report (*2*).

Twenty grams of dry baker's yeast (Fleischmann) is suspended in 80 ml of 5 percent aqueous glycerol solution and stirred vigorously for 2 hours at room temperature with a Herschberg wire stirrer (Nichrome wire loops on a glass rod). The brei is then centrifuged at 1000 *g* for 30 minutes in the cold, and the supernatant is dialyzed against four changes of distilled water over a 24-hour period at 7°C to remove the glycerol. The homogenate (approximately 60 ml) contains particulate material but no whole cells or cell-wall debris. It is then diluted to 80 ml and divided into 20 Erlenmeyer flasks, each containing 1.0 mg of adenosine-5′-triphosphate (ATP), 1.3 mg of diphosphopyridine nucleotide (DPN), 1.6 mg of coenzyme A (CoA), 5 mg of methionine, 4 mg of $MgSO_4$, 8 mg of $NaNO_3$, 4 mg of K_2HPO_4, 2 mg of KCl, 0.04 mg of $FeCl_2$, and 20 mg of "tris" buffer (*p*H 7). Five microcuries of sodium acetate-1-C^{14} (0.41 mg) is added to each flask.

The incubation is carried out at room temperature in cotton-plugged flasks mounted on a rotary shaking table. After 48 hours, 4 ml of methanol and 0.8 g of potassium hydroxide pellets are added to each flask, and the mixture is hydrolyzed on a steam bath for 16 hours. The hydrolyzate is extracted with pentane, and the pentane phase is washed thoroughly with alkali. The sterols are isolated by precipitation with digitonin, followed by cleavage with pyridine and recrystallation. Radioactivity is measured in a gas-flow counter in which 1 μc is equivalent to 3×10^5 count/min.

Proper stirring of the yeast suspension in the glycerol solution is quite important. Gentle shaking on a rotary table produces weak homogenates. Suspensions digested with diammonium phosphate or treated in a Waring Blendor, in a Potter-Elvehjem or Virtis homogenizer or in a Hughes press also gave only weakly active extracts. Table 1 demonstrates the role of various cofactors in the system. The methionine requirement has been explored in experiments with methionine-methyl-C^{14}, which was found to yield ergosterol-28-C^{14} (*3*). Aeration during incubation is essential. Homogenates incubated under nitrogen gave only 17 percent of the yield in a comparable aerobic incubation. Potassium cyanide ($1 \times 10^{-3}M$), α,α-dipyridyl ($1 \times 10^{-3}M$), and digitonin ($1 \times 10^{-4}M$) strongly inhibit synthesis of sterols. In one experiment, varying quantities of sodium acetate were used to determine the capacity of the system to convert acetate into sterols, and it was found that 2 mg of acetate was the maximum that could be efficiently utilized by 4 ml of homogenate in 48 hours.

The duration of incubation determines the extent of incorporation of C^{14} into sterols. After 48 hours, one-third of the C^{14} in the nonsaponifiable fraction has been incorporated into sterols.

The homogenate remains active for a long time. In several experiments a small increase in incorporation of C^{14} into sterols was found even after a 96-hour incubation. Since the homogenate is apparently not a very good growth-supporting medium, proper care during its preparation is sufficient to prevent contamination in 90 percent of the cases. Passing it through a Seitz filter into sterile flasks prior to incubation eliminates the remaining contaminants. This has been verified by microscopic examination both before and after incubation. Contaminated flasks usually show a lower yield of sterols, probably because whole cells divert acetate to other uses.

Standing at 7°C for 24 hours prior to incubation does not materially affect the activity of the preparation, but standing in 5 percent glycerol solution decreases the efficiency of ergosterol synthesis.

Table 1. Cofactor requirements. Yeast homogenate was incubated for 48 hours at room temperature.

Cofactor	Total C^{14} in sterols (10^3 count/min)	Decrease in yield (%)
None	5.1	
Yeast hydrolyzate (30 mg)*	22.4	
Complete system	43.3	0
ATP omitted	24.5	43.5
DPN omitted	37.3	13.9
CoA omitted	39.7	8.2
Methionine omitted	22.4	48.4
$MgSO_4$ omitted	24.5	43.4

* Nutritional Biochemicals Corp., Cleveland, Ohio. It lacks any inherent enzymatic activity in this system.

GEORGE J. ALEXANDER
Worcester Foundation for Experimental Biology, Shrewsbury, Massachusetts

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24 July 1957

Differentiation of Species by Paper Electrophoresis of Serum Proteins of Pseudemys Turtles

Serum proteins of a number of vertebrates, including the turtle, have been studied by paper electrophoresis, and differences between major groups have been noted (*1*). Several workers have used protein composition in taxonomic studies, employing precipitin or electrophoretic methods (*2*, *3*). The present work (*4*) was undertaken to compare the serum proteins of closely related turtle species.

Striking differences were observed when 22 individuals representing three different species of the turtle genus *Pseudemys* were analyzed by paper electrophoresis. Included were three races of *P. scripta* (*scripta*, *elegans*, and *gagei*) from four widely separated localities (Florida, Kansas, Louisiana, and Mexico), *P. nelsoni* from Florida, and three races of the *P. floridana* complex (*floridana*, *suwanniensis*, and *mobilensis*) from two localities (Florida and Louisiana). While the representatives of the *P. floridana* complex are currently considered to be subspecies of a single species (*5*), the *floridana* and *suwanniensis* examples from Florida exhibit biological relationships characteristic of distinct species—namely, reproductive isolation in microgeographic sympatry (*6*). Further evidence presented in this report indicates a difference between the serum proteins of these two forms which substantiates a species level relationship (*7*).

Our paper electrophoresis techniques were the same as those described by Durrum (*8*); we used Spinco model R, series B apparatus; barbital buffer (ionic strength 0.05; *p*H 8.6); Heath Kit constant-voltage power supply (300 v d-c);

and a 5-hour run. Proteins were made visible with bromphenol blue and zinc sulfate, and lipoproteins with Oil Red O. Dyed protein strips were scanned and analyzed quantitatively with the Spinco Analytrol instrument. Twenty- to forty-microliter samples were applied on Whatman No. 3 MM paper strips. Blood samples were collected by severing a carotid artery and draining the blood directly into a 15-ml centrifuge tube. After the blood had clotted and had been centrifuged, a clear serum was obtained.

Figure 1 shows the paper electrophoretic patterns of the serum of four turtle forms, as well as the pattern of a sample of human serum for comparison. Table 1 gives the values for relative and total protein concentration, as determined with the Analytrol (*4*).

The results indicate that the fastest moving fraction of turtle serum (fraction V) has about the same mobility as human α_1-globulin. Fraction IV migrates to a position between α_2- and β-globulins. It thus appears that none of the turtle serum proteins is comparable to human serum albumin in its electrophoretic behavior. Another turtle serum protein (fraction II) has zero mobility, and a further fraction (I) exhibits apparently cathodic mobility, similar to human serum γ-globulin. Protein fraction III is common to all turtle sera examined and appears to be a lipoprotein upon staining with Oil Red O. This lipoprotein could be concentrated by dialyzing turtle serum against distilled water for 36 hours, when a precipitate formed; this precipitate, on electrophoretic analysis, appeared to be an immobile, possibly denatured, lipoprotein.

The most striking difference between the serum protein fractions of the four turtle forms examined is that *scripta* and *nelsoni* have a single band V, while *P. floridana* and *P. suwanniensis* exhibit double bands of the same electrophoretic mobility as band V. When less than 10 μl of serum was applied to the paper strip, band V was observed sometimes as a diffuse streak rather than as a distinct band or bands. The serum protein fractions of *scripta* and *nelsoni* are similar, except that the over-all protein concentration in the serum of *nelsoni* is higher than that in *scripta*.

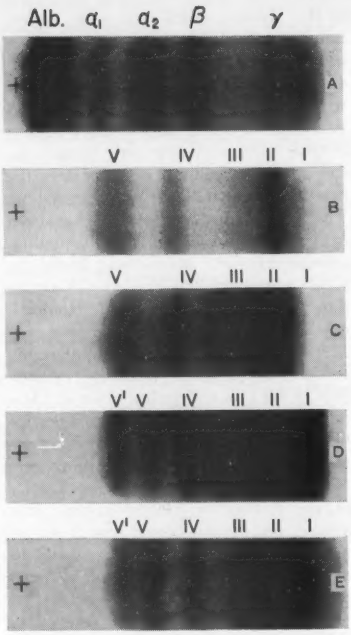

Figure 1. Paper electrophoresis patterns of serum proteins of turtles of the genus *Pseudemys* and of the serum protein of a human being (*A*) for comparison. Other patterns represent the species *scripta* (*B*) and *nelsoni* (*C*) and two subspecies, *floridana* (*D*) and *suwanniensis* (*E*), of the species *floridana*.

Table 1. Relative and total concentration of turtle (*Pseudemys*) serum proteins as determined by Analytrol.

Species	Protein fraction (% of total)				Total (Analytrol units)
	I, II and III	IV	V	V′	
P. scripta	60.3	15.1	24.6		211
P. nelsoni	66.1	16.0	18.0		274
P. floridana floridana	76.2	9.9	7.3	6.5	353
P. f. suwanniensis	63.8	12.9	15.0	8.3	240

Only one example of *nelsoni* was available for these studies, and the observations regarding this form are tentative pending confirmation. In comparing the other two forms, it may be seen from Fig. 1 that protein IV in *floridana* has a greater relative concentration than V or V′, while fraction IV in *suwanniensis* appears (see Fig. 1) to be about equal in density to V and V′. Analytrol readings of *suwanniensis* show that IV is actually more concentrated than V′ but less than V. Fractions I, II, and III of *floridana* are usually more concentrated than the respective fractions of *suwanniensis*. The serum of one individual of *suwanniensis* showed two distinct bands III and III′, indicating the presence of two lipoprotein fractions which may be present but are not resolvable in the other animals studied.

Serum proteins of the nine examples of *scripta* exhibited no observable geographic variation. Slight variation in relative concentration and mobility of the lipoprotein fraction in different samples appears to be correlated with the age of the sample. In these studies it has been found that there are two basic protein patterns, one in which there is a single protein V (for example, in *nelsoni* and *scripta*), the other with two protein fractions V and V′ (for example, in *floridana* and *suwanniensis*). This would suggest that *scripta* and *nelsoni* may be more closely related to each other than to the *floridana* complex. Morphologic and zoogeographic evidence is not entirely consistent with this hypothesis.

The similarity of serum protein patterns of *floridana* and *suwanniensis* supports the conclusion of close relationship that is also indicated by other evidence (*5*). However, the observed difference in protein concentration between these two forms suggests that they are less closely related to one another than are the different subspecies of *scripta* which were examined. While the subspecies of *scripta* were indistinguishable, four examples of *suwanniensis* were clearly differentiable from three specimens of *floridana* from the same area on the basis of protein concentration. This observation, while consistent with the local species-level relationship of *floridana* and *suwanniensis*, would suggest that differences in protein concentration may evolve quite rapidly, as noted in these subspecies.

In Louisiana the subspecies *P. f. mobilensis* replaces *suwanniensis* ecogeographically and is sympatric with *floridana* just as *suwanniensis* is in Florida. However, reproductive isolation of *floridana* and *mobilensis* in Louisiana is not complete. A high incidence of hybridization has been reported in this area, and genetic introgression has been suggested (*6*). Of a series of four Louisiana specimens obtained, two were judged by morphologic, diagnostic characters to be most similar to *mobilensis* and two to *floridana*; however, other characters suggested hybrid ancestry. The serum protein patterns of the four animals were found to be undifferentiable from one another, exhibiting the pattern of *floridana*, including the dense band IV. This similarity supports the hypothesis of hybrid origin of these specimens.

McCabe and Deutsch (*3*), who used electrophoresis of proteins (bird egg white) as a taxonomic tool, found the method more sensitive for comparisons above rather than below the generic level. The results reported here suggest that the technique of paper electrophoresis may be effectively employed in intrageneric comparisons of some animal groups.

GUNTER ZWEIG*
C. F. Kettering Foundation, Yellow Springs, Ohio
JOHN W. CRENSHAW
Biology Department, Antioch College, Yellow Springs, Ohio

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* Present address: Pesticide Residue Research Project, University of California, Davis.

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Increase in Resting Membrane Potential of Skeletal Muscle Produced by Insulin

Although the mechanism of action of insulin is not known, evidence is accumulating to suggest that it alters the rate at which certain substances enter skeletal muscle. Stadie, Haugaard, and Vaughan (*1*) showed that insulin affixes itself firmly to muscle, perhaps to the muscle membrane. Levine, Goldstein, Huddlestun, and Klein (*2*) demonstrated increased movement of glucose and related hexoses into muscle in eviscerated animals, and Park and Johnson (*3*) confirmed the phenomenon in the rat. Fisher and Lindsay (*4*) made essentially the same observation in the isolated, perfused rat heart. These observations do not distinguish between an effect of insulin on muscle membrane and an effect on a hypothetical hexose transport system.

Recently use has been made of the fact that aldolase, an intracellular enzyme, diffuses from muscle incubated under a variety of conditions (*5*). Alterations in the rate of diffusion of aldolase are attributable to changes in membrane permeability; no transport mechanism need be invoked. Insulin increased the rate at which aldolase diffused from isolated rat muscle; this is presumptive evidence that insulin altered membrane permeability.

The sum of these observations suggests that insulin becomes associated intimately with the muscle membrane, perhaps deforming it to alter permeability. If this is true, the association between insulin and muscle membrane might lead to altered electrical properties of the membrane. From the well-known effect of insulin on serum potassium concentration, it was suspected that insulin might hyperpolarize the muscle membrane.

Insulin administered to the intact animal causes a decrease in concentration of potassium in serum owing at least in part to movement of potassium from extracellular fluid into muscle. The consequent increase in ratio of activities of intracellular and extracellular potassium should lead to hyperpolarization of the muscle membrane. However, there is no satisfactory explanation for the movement of potassium induced by insulin. It was conceivable that, rather than producing intracellular migration of potassium, which then caused a change in membrane potential, insulin might act by first hyperpolarizing the membrane; this, in turn, would lead to intracellular migration of potasium, impelled by the new potential difference.

For these reasons the effect of insulin on resting membrane potential of isolated rat skeletal muscle was examined (*6*). Insulin caused hyperpolarization of the membrane.

The test system was the peroneus longus muscle of the rat. The muscle was excised by freeing it gently and cutting its tendons without transection of muscle fibers. In young rats this muscle weighs about 25 mg and exhibits stable resting membrane potentials for several hours. The muscle was placed at rest length in an appropriate perfusion system containing balanced buffered saline-glucose-HCO_3 solution and K^+ at 4.7 milliequivalents per liter; it was then gassed with 95 percent O_2, 5 percent CO_2. Intracellular puncture was performed with KCl-filled microelectrodes of impedance of approximately 15 megohms. Signals were led through conventional circuitry and displayed on a cathode-ray oscilloscope at a scale of 25 mv/in. After the muscle had been probed widely and it had been determined that resting potentials were stable, insulin was added to the system; resting membrane potentials were measured from approximately the 20th to the 60th minute thereafter. In several experiments, as a control on changes with time, potentials were measured either in the absence of insulin or in its presence but not in both circumstances.

In 207 impalements in six muscles in the absence of insulin, resting membrane potential was 70 ± 0.7 mv (standard error of the mean; S.E.M.). In 320 impalements in six muscles in the presence of insulin, 0.1 to 0.3 unit/ml, resting membrane potential was 75.4 ± 0.5 mv (S.E.M.). Insulin produced an increase of 5.4 ± 0.89 mv (S.E.M.), a highly significant difference by t test ($t = 6$, $P \ll 0.0001$). Data from four paired experiments appear in Table 1. Insulin produced hyperpolarization, highly significant by t test, in all pairs.

The mean increase in membrane potential was 8 percent. Were this the result of movement of potassium from perfusion fluid to intracellular fluid, the ratio of activity of potassium inside muscle to that outside would be required to increase by about 50 percent, in accordance with the equation

$$\frac{E_R''}{E_R'} = \frac{\ln (K)_i''/(K)_o''}{\ln (K)_i'/(K)_o'} = 1.08$$

where E_R is the resting membrane potential, $(K)_i$ is the activity of potassium inside the cell, and $(K)_o$ is its activity outside the cell; single primes refer to control muscles and double primes to muscles after exposure to insulin. If the true mean increase were as small as two standard errors less than the observed mean increase in resting potential, the ratio of activities of potassium would have had to increase by about one-third.

Potassium concentration of perfusion fluid was, by design, held constant owing to the large volume of fluid, approximately 150 ml, compared to the small mass of muscle. Analysis of potassium in perfusion fluid by flame photometry demonstrated that its concentration was indeed constant.

Both peronei longi from a rat were removed. One muscle was placed in 150 ml of insulin-free perfusion fluid and gassed simultaneously with its mate in which membrane potentials were measured and which was exposed to insulin. At the end of the experiment the muscles were analyzed for potassium. In five pairs of muscles $(K)_i$ increased by 1, 14, 25, 27 and 44 percent. The greatest increase occurred in a muscle in which membrane potential increased by 14 per-

Table 1. Hyperpolarization of muscle membrane produced by insulin.

Insulin concentration (units/ml)	Fibers measured (No.)	Resting membrane potential*			
		Control (mv)	Insulin (mv)	Difference (mv)	P†
0.1	135	69.4 ± 1.6	75.4 ± 1.1	5.9 ± 1.9	< 0.01
0.3	124	70.6 ± 1.8	76.3 ± 1.0	5.7 ± 2.1	< 0.01
0.1	90	61.5 ± 1.0	68.5 ± 1.2	7.0 ± 1.6	< 0.001
0.1	58	71.7 ± 1.9	81.3 ± 1.5	9.6 ± 2.6	< 0.001

* Potentials are given as mean ± standard error of the mean. † P is probability that the difference measured occurred by chance, estimated by t test.

cent. In this instance, an increase of more than 100 percent is required to account for the hyperpolarization. In no case could the rise in intracellular potassium account alone for the observed increase in resting membrane potential, and the average increase at the end of 1 hour's exposure to insulin was less than half that theoretically required to cause the hyperpolarization.

These data, with earlier data on the effect of insulin on aldolase efflux, are interpreted to indicate that insulin can act by its association with muscle membrane and that the insulin-membrane complex results in spatial changes in the barrier to diffusion, increasing membrane permeability and simultaneously increasing the potential difference across the membrane. In response to increased potential difference across the membrane, potassium moves into muscle toward a new equilibrium ratio of concentrations.

KENNETH L. ZIERLER
Department of Medicine, Johns Hopkins University, Baltimore, Maryland

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Balanus Fouling of Shrimp

Fouling of commercial crabs (*Callinectes sapidus*) and lobsters (*Homarus americanus*) by various species of barnacles (*Balanus*) is a common occurrence (*1*) but the presence of maturing sessile barnacles on shrimp is noteworthy. This report is based on observation of four *Balanus*-fouled white shrimp (*Penaeus setiferus*) taken from the inshore waters of Mississippi and South Carolina during the winter of 1957.

The single Mississippi specimen (*2*) was collected at the mouth of Ocean Springs Harbor, Biloxi Bay, on 17 February. This was a 90-mm male carrying five small (less than 2-mm basal diameter) unidentified *Balanus*. The barnacles were attached along the mid-dorsal line of the fourth, fifth, and sixth abdominal segments.

The South Carolina specimens were

Fig. 1. *Penaeus setiferus* (119-mm female) with 4-mm *Balanus amphitrite niveus* attached to the first abdominal segment.

taken from the Edisto River system on 2, 11, and 25 March. These shrimp, two males (125 mm and 150 mm) and one female (119 mm) each carried a single barnacle. The female (Fig. 1) and smaller male were each fouled with a 4-mm (basal diameter) *Balanus amphitrite niveus* Darwin on the first abdominal segment. The barnacle on the female was located 1 mm to the right of the mid-dorsal line, whereas the attachment site on the male was 2 mm to the left. The remaining shrimp carried a 9-mm *Balanus improvisus* Darwin dorsolaterally on the fifth abdominal segment with the left edge of its base on the mid-dorsal line (*3*).

Smith (*4*) showed that, at Miami, *B. amphitrite niveus* attained a size of 4 mm in 13 days during February, and McDougall (*5*) indicated that some individuals of *B. improvisus* attain, in December and January, a size of 13 mm in 42 days at Beaufort, N.C. Gunter and Geyer (*6*) gave data showing a minimal winter growth rate for *B. improvisus* of 0.13 mm per day off the Louisiana coast. No data are available on the winter growth of *Balanus* in South Carolina, but it is reasonable to assess minimal growth periods of 10 and 25 days for the 4 mm and 9 mm *Balanus* found on local shrimp. The age of the Mississippi barnacles is estimated at about 2 weeks.

Since fouling can become established only during interecdysal periods, the balanoids developed between the previous molt and time of capture. None of the shrimp showed signs of imminent shedding. Winter growth of shrimp is minimal (*7*), and fouling by maturing barnacles is probably confined to this period of reduced molting frequency.

The capture of four fouled shrimp from the Atlantic and Gulf coasts within a short space of time suggests that careful observation of winter shrimp catches may reveal numerous instances of this association between *Balanus* and *Penaeus*. Analysis of the growth of attached *Balanus* might yield information on winter molting frequencies of individual shrimp.

C. E. DAWSON
Bears Bluff Laboratories, Wadmalaw Island, South Carolina

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14 August 1957

Enzyme-Inhibitor Complex in a Tryptophan-Requiring Mutant of Neurospora crassa

Numerous reports indicate that gene mutations can cause the loss of specific enzymatic activities (*1*). It is important, from both a genetic and a biochemical standpoint, to know whether such mutant cells continue to synthesize enzymatically inactive molecules structurally related to the enzyme. The presence of a serologically active protein closely related to the enzyme tryptophan synthetase has been demonstrated in a number of allelic tryptophan-requiring mutants of *Neurospora crassa* which lack the enzyme (*2–4*). Similar results have also been found in *Escherichia coli* (*5*).

The present study (*6*), in which a temperature-sensitive, tryptophan-requiring mutant of *Neurospora crassa* (*7–9*) was employed, indicates that highly active preparations of tryptophan synthetase can be obtained from *inactive* crude extracts of this mutant when the crude extracts are purified by using protamine

sulfate, ammonium sulfate, and alumina gel. Methods for the extraction and purification of wild-type tryptophan synthetase have been previously described (*4, 10*). Evidence is presented suggesting that this activation may involve the dissociation of an enzyme-inhibitor complex.

As shown in Table 1, the amount of tryptophan synthetase present in mutant strain td_{24}, after activation, is about 30 percent of the amount present in the wild-type strain. Attempts to activate crude extracts of this mutant by heat, salt (NaCl) dissociation, acid, or dialysis have not been successful thus far.

It has been possible to inhibit the activated enzyme completely by adding back a 23 to 50 percent ammonium sulfate fraction, resuspended in 0.1*M* phosphate buffer at *p*H 7.8, or by using aliquots of the crude, unfractionated extract. The results of experiments on the effect of inhibitor concentration indicate that a linear relationship exists between inhibitor concentration and percentage inhibition, suggesting that a stoichiometric combination of enzyme and inhibitor may occur (*9*). A low dissociation constant for the complex is suggested, for no protective or competitive effect is exerted by the substrate or the coenzyme (*9*).

The inhibitor precipitates over a fairly wide concentration range of ammonium sulfate. The inhibitory fraction has the following properties: (i) stable to boiling; (ii) precipitated but not inactivated by 10 percent TCA; (iii) dialyzable; (iv) partially adsorbed on alumina gel; (v) not absorbed on charcoal; (vi) stable to 2-hour refluxing in concentrated HCl; (vii) partially precipitated by 95-percent ethanol; and (viii) stable to ashing. Whether the inhibitory material consists solely of one or more metals is not yet known, but there is evidence that metals may play a role in both the function and formation of tryptophan synthetase (*11*).

The inhibitor has been obtained from all of the *td* mutants (*12, 13*) examined, but attempts to activate the enzyme in strains other than td_{24} have proved unsuccessful to date. The inhibitor has also been obtained from several wild-type strains (*9*). The inhibitor-sensitivity of the mutant and wild-type enzymes has been compared at similar levels of specific activity, and the mutant enzyme is exceedingly more sensitive to the inhibitor (*9*). The inhibitor from *Neurospora* is also effective against tryptophan synthetase from *Azotobacter vinlandii* (*14*), but it has no effect on *Neurospora* alcohol dehydrogenase (*15*).

Table 1. Effect of fractionation on crude extracts of mutant td_{24} lacking tryptophan synthetase activity. Both strains td_{24} and 5256A were incubated at 25°C for 3 days. Strain td_{24} was grown in Fries minimal medium plus DL-tryptophan, while strain 5256A was grown in minimal medium alone. Mycelia were grown, harvested, extracted, fractionated, and assayed by methods already described (*4, 10*).

Strain	Tryptophan synthetase (unit/ml)	Protein (mg/ml)	Specific activity*
	Crude extract		
Mutant td_{24}	0.0	13.6	0.0
Wild-type 5256A	43.5	13.2	3.3
	Fractionated preparation		
Mutant td_{24}	76.0	10.0	7.6
Wild-type 5256A	196.0	9.4	20.9

* Specific activity = units of enzyme per milligram of protein.

These preliminary findings suggest, at least in the case of mutant td_{24}, that gene mutation has not prevented the formation of tryptophan synthetase. Rather it would seem that an active protein is formed which may immediately combine with a readily available inhibitor. This likelihood is also suggested by earlier work on tryptophan synthetase formation in *Neurospora* (*16*).

The fact that the inhibitory material is found in the wild-type as well as the mutant organism indicates that the material is a normal cell component. As has already been mentioned, the mutant enzyme appears to be considerably more sensitive to the inhibitor than is the wild-type enzyme. One interpretation of these results is that the td_{24} enzyme may be a structurally altered protein (*1, 17*) which has an extremely high affinity for some normally occurring cell constituent, forming with it, *in vivo*, an enzymatically inactive indissociable complex. One of the possibilities being considered is that the protein antigenically related to tryptophan synthetase in *td* mutants of *Neurospora* lacking the enzyme (*2, 4*) may be an enzyme-inhibitor complex. Perhaps, as Beadle contends (*18*), specific suppressor genes, effective in partially restoring tryptophan synthetase activity in certain *td* mutants (*13*), may function by controlling the level of an inhibitor, or possibly by creating an intracellular environment that favors dissociation of an enzyme-inhibitor complex.

The fact that tryptophan synthetase from the wild-type organism is much more resistant to the inhibitor *in vitro* (*9*) suggests either that the dissociation constant of the complex *in vivo* may be high or that a mechanism may exist in the normal cell for controlling complex formation. The significance of enzyme-inhibitor combinations as potential regulatory mechanisms in cellular metabolism has recently been pointed out by several workers (*19*).

SIGMUND R. SUSKIND
LORETTA I. KUREK

McCollum-Pratt Institute,
Johns Hopkins University,
Baltimore, Maryland

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9 August 1957

Book Reviews

Technology and Social Change. Francis R. Allen, Hornell Hart, Delbert C. Miller, William F. Ogburn, Meyer F. Nimkoff. Appleton - Century - Crofts, New York, 1957. 529 pp. Illus. $7.

The two central themes of this work are the acceleration in technological developments and the ensuing cultural lags caused by the slow adjustment of man's cultural, social, and political institutions to the ever-faster-developing technological environment. In chapter 3 Hornell Hart gives a very impressive picture of this acceleration; in prehistoric and early historic times it was very slow, but then, as a result of scientific discoveries and technical inventions, it became so rapid that we may compare the technological progress made in this century with all the previous progress made by man since his appearance on earth. Man's accelerating efficiency in cutting tools, his accelerating mastery of physical power, the speed-up of movement and communication, and the rapid development in disease control and physical comfort are no less spectacular than his power to kill and to destroy, which outruns all effective efforts to organize its control on a world-wide basis.

In the chapters that follow, the influence of the automobile and of motion pictures, radio and television, aviation, and atomic energy on social institutions is very vividly discussed, and their impact upon industry and agriculture, medicine, family life, and political organization is outlined. While we have made great progress in the physical and biological sciences and have used our rapidly increasing knowledge for both constructive and destructive purposes, our advances in the social sciences have lagged ever farther behind; still greater is the lag in their effective employment in the resolution of the world crisis, which, according to Ogburn, consists in the strain between two correlated parts of culture that change at unequal rates. After giving careful consideration to the cultural lag hypothesis, Hart and Allen elaborate on the major problems arising from rapid social change under a condition of ever-widening cultural lag. In this connection they deal, in an illuminating manner, with the baffling problems of contact between the progressive, industrialized nations and the underdeveloped, backward ones—problems that are but typical examples of cultural lag.

While the authors' attempt to illuminate technological acceleration and cultural lag is very effective and extremely instructive, their endeavors to find solutions for some of the problems created by cultural lag are, naturally enough, less satisfactory. But would it not be too much to expect to find in a book by social scientists, however eminent, and however penetrating and comprehensive the book, the solution to the deep-rooted world problems to which the best brains of the world's statesmen, politicians, and social and physical scientists have devoted all their energy with so little result? It appears to me that the solution cannot be found within the material and organizational dimension of our culture but should be sought in man's moral and religious character, the discussion of which, however, would have transcended the objective which the authors have set for themselves.

This objective has been attained in a very admirable way and, for this reason, the book is recommended as giving plenty of food for thought and the raw material with which to build a socially better balanced society and more stable world organization. The summaries and annotated bibliographies at the end of each chapter are very welcome.

FRANCIS JOSEPH WEISS
Washington, D.C.

Niels Henrik Abel, Mathematician Extraordinary. Oystein Ore. University of Minnesota Press, Minneapolis, 1957. 277 pp. $5.75.

Biographies have an inherent fascination, and biographies of great scientists, in addition, are intriguing because we may hope from them to gain insight into the way in which new science is created. Moreover, such biographies have a certain topical importance at a time when the public is concerned with the national need for more original minds in science.

In his short 27 years of life, Abel established a place as one of the great mathematicians of the 19th century. Like his contemporary, Galois, he was stimulated and supported by a few teachers and contemporaries, misunderstood and neglected by public officials, and subjected to the experience of having important papers "lost" by his seniors in the mathematical hierarchy of the period. Oystein Ore's biography is sympathetic but judiciously objective in tone. The author is restrained in his discusson of mathematical technicalities but includes enough for the mathematician.

This is an enjoyable book for anyone interested in biography or the history of science. Upon putting it down, the reader will say to himself that, in our time, such a genius would not go so unappreciated and unrecognized. And yet one cannot help wondering whether today the young scientist does not face hazards of an even more insidious kind. He is not likely to be denied a livelihood, but is it not possible that the pressure for conformity, the large group projects, and the custom of measuring "success" by the volume and fashionableness of publication, rather than by originality, may cause some of our contemporaries to spend a life of comfortable mediocrity less productive than the brief and unhappy career of Abel?

KENNETH O. MAY
Carleton College

The Making of a Moon. The Story of the Earth Satellite Program. Arthur C. Clarke. Harper, New York, 1957. 205 pp. Illus. $3.50.

No one who has read any part of the technical and scientific literature on the artificial earth satellite, or for that matter even the supposedly nonscientific articles such as have appeared recently in *Life, Fortune,* and other similar journals, is likely to learn anything very significant from this newest book by Arthur Clarke. However, the book is written in the same delightful semihumorous style as *The Exploration of Space,* the only previous book by this author with which I am personally familiar. *The Making of a Moon* is easy reading, and well worth the few hours it will take to finish it, especially for anyone who wants to acquire an informal acquaintance with this fascinating field as painlessly as possible.

For the most part, Clarke stands on solid ground, both technically and scientifically. He deserves much credit for avoiding the obvious temptation to echo Wernher von Braun's scare headlines about the possibility of satellites being used as impregnable launching bases for atomic missiles; in fact he demonstrates in a common-sense way that a satellite is unlikely to be either impregnable or to possess any particular advantage as an offensive missile base. Furthermore, he takes much of the confusion

out of a number of popularly misused phrases, such as "beyond the Earth's gravity" and "where the atmosphere ends," for which he should be commended. His treatment of the propulsion, staging, guidance, and control, and construction of the Vanguard launching vehicles, as well as of the elementary mechanics of the orbit, is both technically correct and understandable to the uninitiated—a combination not always achieved by other writers.

A few errors will be noted—but only, I suspect, by those who are rather close to the IGY program. For example, the final velocity of the satellite is given in Table 1 as 17,000 miles per hour. Actually, this is approximately the minimum velocity which must be obtained. As Clarke himself points out a few pages later, "it is safer to aim for a speed slightly in excess of the minimum," and this is in fact being done. Thus, if all goes well, the actual velocity at third-stage burnout will be more nearly 18,000 miles per hour. The discussion of orbit precession and other perturbations is disappointingly brief and incomplete, and although the illustrations are, for the most part, well drawn, there is no good three-dimensional representation of the 35-degree inclined orbit. Further confusion is introduced, at least for me, by the statements that the "orbits of the IGY satellites will cross the Equator at about forty degrees" and as a result will swing back and forth "between the parallels of 35° North and 35° South," and by reference to the orbital period as being 90 minutes. (At the 300-mile altitude, the period should be more than 100 minutes.)

The most significant shortcomings, however, occur in the chapter entitled, "Laboratory in Space." It is implied, for example, by an unfortunate juxtaposition of paragraphs, that useful measurements of the earth's magnetic field could be made by detecting the decrease in spin rate of the satellite which will result from eddy currents generated by this field. No mention is made of the proton-precession magnetometer which will in fact be used or of any of the alternative types which have been considered. Although the relationship of solar flares to the variation in ultraviolet and x-ray intensity reaching the earth is covered briefly, there is no mention of the more interesting relationship between solar flares and cosmic rays and, particularly, of the interesting hypothesis that cosmic rays produced in the sun must somehow be stored for periods of many hours in some sort of magnetic box out in space.

There is also something lacking in the discussion of a possible relativity experiment. This discussion refers to the difference in time as measured by idealized clocks traveling at different speeds, as predicted by the special theory of relativity. However, this theory assumes no acceleration of either vehicle and therefore could not be confirmed by tests in a satellite, which of course is continually changing the direction of its velocity vector. Furthermore, the special theory of relativity is by now so well accepted that it scarcely requires any additional confirmation. What Clarke probably has in mind is a suggestion which has been made by several competent scientists to the effect that the general theory of relativity, which predicts a difference in the time measured by ideal clocks, depending on the gravity-acceleration field, might be confirmed by tests made in a satellite. Clocks having sufficient accuracy do indeed exist, and contrary to Clarke's statements, they can probably be designed in such a way as to be carried even in a relatively small, unmanned satellite.

Other surprising statements in *The Making of a Moon* are that the heart normally "has to do work against gravity, like any other pump," and that fish are "immune to gravity." Actually, any good high-school physics student is aware that both the inlet and the outlet of the heart are at the same gravitational potential and that the only work done by the heart is in overcoming the friction of the circulatory system. Also, the fish could hardly be said to be any more immune to gravity than a man sitting in a chair. Both are supported by increased pressure on the bottom side.

Despite these and other errors—for the most part trifling and occasionally amusing—the main thread of the satellite story comes through loud and clear. Many of us could benefit by a study of Clarke's simple, effective style of writing. It is to be hoped that, after the IGY is over and both United States and U.S.S.R. satellites have been launched, Clarke will write another book summing up the accomplishments.

RICHARD W. PORTER
General Electric Company and
Technical Panel on the Earth Satellite Program, U.S. National Committee for the I.G.Y.

Bibliography of Plant Protection, 1946–1947. J. Barner. Biologische Bundesanstalt, Berlin, 1957. 460 pp.

This 1957 bibliographic volume lists more than 13,800 titles for the years 1946 and 1947. Already published are 24 previous volumes covering the phytopathological literature for the years 1914–45 and 1950–51. Volumes covering the 1948–49 period are promised in the near future. The present volume follows, in general, the format and type of content characteristic of the preceding volumes; it is paper-bound and excellently printed. The introductory parts and the principal headings under which the titles are classified (alphabetically according to author) are presented in three languages: German, English, and French. The primary divisions of the volume are "General Works," "Diseases and Causes," "Diseases and Host Plants," and "Measures of Plant Protection." There is also an index to authors.

Gmelins Handbuch der Anorganischen Chemie. *Calcium.* Occurrence, the Element, the Alloys. System No. 28, part A, section 2. xii + 420 pp. Illus. $55.68; *Zinc.* System No. 32, supplement. xxxvi + 1025 pp. Illus. $138; *Platinum.* Complex Compounds with Neutral Ligands. System No. 68, part D. liv + 638 pp. $90. E. H. E. Pietsch, Ed. Verlag Chemie, Weinheim/Bergstrasse, Germany, ed. 8, 1957.

Calcium. This section, which deals with the occurrence of calcium, calcium the element, and calcium alloys, completes part A of system No. 28. Part A, section 1, covered the history of the element.

The portion on occurrence deals with the cosmic distribution of the element, its geochemistry, its economic geography, and its minerals. That on the element itself concerns its preparation, physical properties, electrochemical and chemical behavior, physiological hazards, detection, and determination, as well as the general reactions of calcium salts. The third portion is devoted to alloys of calcium with antimony, bismuth, lithium, sodium, potassium, and beryllium. The literature is covered to 1949.

Zinc. This comprehensive supplementary volume covers the material which appeared from 1924 to 1949 and is three times the size of the first volume on zinc, which was published in 1924.

The volume features an entirely new chapter on the geochemistry of zinc, a detailed account of the metallurgy of zinc, the preparation of important zinc salts, physical properties, electrochemical and chemical behavior, zinc alloys, and compounds of zinc with other elements. It comprises the most complete account of zinc yet published.

Platinum. This new volume completes the platinum series, which includes parts A, B, and C, published between 1938 and 1951.

This last volume is devoted to complex platinum compounds involving neutral ligands and describes the chemistry of 2880 compounds. A special feature is a detailed introduction dealing with the arrangement of the material of the volume, nomenclature, formulas, and a summary of the more important ligands and their abbreviations as well as a sum-

mary of Russian literature and transliteration of Russian names. Also, in the introduction, attention is centered on the *trans-effect,* discovery of which has helped to advance the state of knowledge of these compounds. The bulk of the volume is concerned with the description of individual compounds.

The Gmelin Institute was fortunate in being able to procure the entire Russian platinum literature and, in so doing, to be able to make this vast store of information on complex compounds of platinum available to the outside world. In this instance the literature search was extended through 1953.

These three volumes, prepared with painstaking care and thoroughness, maintain the high standard of excellence characteristic of the other portions of *Gmelins Handbuch.*

RALEIGH GILCHRIST
National Bureau of Standards

Psychology in the Soviet Union. Translated by J. Ellis, M. Ellis, H. Milne, J. McLeish, N. Parsons *et al.* Brian Simon, Ed. Stanford University Press, Stanford, Calif., 1957. viii + 305 pp. Illus. $6.

This book is the result of a joint effort on the part of English educationists and Soviet psychologists to "familiarize English readers with the general direction of Soviet psychology." It includes 20 papers which appeared in Soviet journals during the period 1951–55. These cover a wide variety of topics, from discussions of theoretical concepts to applied investigations. In addition there are two appendixes. One of these, written by Luria especially for the volume, reviews Soviet research in psychopathology; the other, by Zaporozhets and Sokolov, is a report on the XIVth International Congress of Psychology. The Soviet contributions are preceded by the English editors' impartial description of the basic premises in Soviet psychology: dialectical materialism and Pavlov's theory of higher nervous activity.

The main target of Soviet investigations is the relation of language to mental functions. In a theoretical paper on the psychology of understanding, Bogoiavlensky differentiates between spoken words and other auditory stimuli. For a semanticist this is not a new distinction. A psychologist, however, may find some interesting applications of this distinction to the phenomena of generalization, transfer, and extinction.

In other papers dealing with the functions of language, Luria offers a plausible explanation for differences between human conditioning and that of lower animals; Ananiev asserts that "the cultivation of thought and speech is a key factor in sensitizing human sense organs"; Menchinskaya emphasizes its role in the operation of the "law of effect"; and Shvarts demonstrates experimentally the influence of verbal instructions on the visual threshold.

Another important concept in Soviet psychology is that of the *orienting reflex.* A definition of this in terms of phasic and tonic innervation is reminiscent of Henry Head's concept of *vigilance.* The role of orienting reflex is discussed by Sokolov in connection with perception, and by Milerian in relation to voluntary and involuntary attention. There is also a rather lengthy study of Leontiev and Rozanova, dealing with the effect of orientation on incidental learning.

The studies mentioned so far are only a sample, since there is hardly a paper in the whole collection that fails to make a reference to the importance of language or orientation in human behavior and mental activity.

Of more than theoretical interest are Menchinskaya's paper on the psychology of teaching, Lublinskaya's report on the development of thought in prekindergarten children, and Slavina's account of corrective methods used with "intellectually passive" pupils. For specialists in clinical psychology, Luria's review summarizes studies on the correction and restoration of speech and other motor disorders. The net impression from this paper is one of close collaboration between psychologists, physiologists, and medical practitioners, and its carefully annotated references will undoubtedly lead many to seek the original sources.

The weakest feature of the book is the monotonous reiteration of the Marxian-Pavlovian catechism—an obvious concession to the Party's dictum. American psychologists who scrupulously abide by the operational approach will be amused to find themselves labeled "mechanists," "idealists,' and "crude empiricists." The criterion of objectivity apparently lies in the frequency with which references are made to Pavlov's elastic concepts. Paradoxically, all references to the higher nervous activity are inferential, stemming from studies of conditioned reflexes rather than from direct investigation of cortical processes.

The English editors had a difficult task in selecting, translating, and editing the Soviet contributions, and they have accomplished their work with excellence. Comparative psychologists may regret that limitations of space have precluded reports on experiments with lower animals; apart from this omission, however, the articles are representative of a great diversity of psychological endeavor. The scrupulously accurate work of translation is marred by only a few minor typographical errors. Finally, the elegance of style and the general format of the volume will make reading it enjoyable as well as informative.

The editors' greatest contribution is, of course, the idea of producing such a volume. It acquaints English and American psychologists with some novel interpretations of psychological concepts, as well as with some original methods in attacking the problems of behavior. It is difficult to say what will be its effect on the actual program of research in this country; one may be certain, however, that it will awaken an interest in, and a demand for, more works of this type. For this the editors deserve every scientist's profound gratitude.

GEORGE W. BOGUSLAVSKY
Rensselaer Polytechnic Institute

Faune de France. vol. 61. *Hétéroptères Aquatiques.* Raymond Poisson. Lechevalier, Paris, 1957. 262 pp. Illus.

This volume of the *Faune de France* series reflects Raymond Poisson's thorough knowledge of the European fauna as well as his familiarity with world literature concerning the aquatic Hemiptera. In the introductory chapter he provides a brief but informative discussion of phylogeny, anatomy, and habits. The rest of the book consists of keys and individual discussions of genera and species. Each species is described and illustrated. Bionomic information of a general nature is included in the discussion of genera, and for some well-known species there are separate paragraphs concerning habits and life-history.

This and other volumes of the *Faune de France* series are models of style and content that should serve as a challenge to American taxonomists.

REECE I. SAILER
Entomology Research Division,
U.S. Department of Agriculture

Miscellaneous Publications

(Inquiries concerning these publications should be addressed, not to Science, *but to the publisher or agency sponsoring the publication.)*

Some Observations on Soviet Industrial Growth. Occasional Paper 55. G. Warren Nutter. National Bureau of Economic Research, New York, 1957. 16 pp. $0.50.

Science in Creative Living. Science Bulletin No. 5. Athelstan Spilhaus. Science Museum, St. Paul Institute, St. Paul, Minn., 1957. 16 pp. $0.50.

El Mundo Nucleonico. Ricardo Cruz-Coke. Editorial De. Pacifico, Santiago, Chile, 1957. 124 pp.

The Fluoridation of Public Water Supplies. Report of the Commission of Inquiry. Presented to the House of Representatives by command of His Excellency. Department of Health, Wellington, New Zealand, 1957. 240 pp. 8s.

Meetings and Societies

AAAS General Symposium

The theme of this year's Association-wide program, *Moving Frontiers of Science*, which will be presented at the Indianapolis meeting, is "Ideas That Mold Our Work." The program will include three addresses. On the evening of 26 December, S. S. Stevens of the department of psychology at Harvard University will discuss "Measurement and man," and G. C. McVittie of the University of Illinois Observatory will discuss "Distance and relativity." On the afternoon of 27 December, T. Dobzhansky of the department of zoology at Columbia University will discuss "Evolution at work," and there will be a commentary on the program and an opportunity for questions to be addressed to the three speakers. Both sessions will be under the chairmanship of F. S. C. Northrop, Sterling professor of law and philosophy, Yale University. The program has been arranged by the Association's Committee on AAAS Meetings, of which Harry C. Kelly, National Science Foundation, is chairman, and Howard M. Phillips, Arthur W. Galston, Frank K. Edmondson, and F. E. Cislak are members.

Preview of Programs at AAAS Indianapolis Meeting

A number of outstanding programs have been planned for the forthcoming AAAS meeting in Indianapolis. Briefly described here are the programs in biology, engineering, medicine, dentistry, pharmacy, and agriculture.

Programs previously announced are those in mathematics, physics, chemistry, astronomy, and earth sciences.

Zoological Sciences

Section F. Contributed papers, 27 Dec., morning; Harold H. Plough, Amherst College, presiding.

Symposium, cosponsored by the Society of General Physiologists and the American Society of Zoologists: "Current Understanding of Pituitary Function"; arranged by W. R. Breneman, Indiana University, who will preside; 27 Dec., evening. "Pituitary function in cold-blooded vertebrates," Paul A. Wright, University of Michigan; "Pituitary function in warm-blooded vertebrates," W. R. Breneman; "The role of the hypothalamus in pituitary function," A. V. Nalbandov, University of Illinois.

Contributed papers, cosponsored by the American Society of Zoologists and the Society of General Physiologists; 28 Dec., morning; Sears Crowell, Jr., Indiana University, presiding.

Two-session symposium, jointly with Section G and cosponsored by the Society of Systematic Zoology, Ecological Society of America, Genetics Society of America, American Society of Naturalists, American Society of Zoologists, and the Botanical Society of America: "Some Unsolved Problems in Biology, 1957," Part I: "Geographic Distribution of Contemporary Organisms," arranged by H. H. Plough; 28 Dec., afternoon. E. R. Hall, University of Kansas, presiding. "The contribution of Pleistocene paleoecology," Paul S. Martin, University of Montreal; "Distribution patterns in the flora of eastern North America," Aaron J. Sharp, University of Tennessee; "Geographic distribution of insects," H. H. Ross, Illinois Natural History Survey; "Distributional patterns of vertebrates in the southern U.S. in relation to past and present environments," W. Frank Blair, University of Texas; "The Palearctic element in the new world avifauna," Kenneth C. Parkes, Carnegie Museum; "Modern mammals," E. Lendell Cockrum, University of Arizona.

Vice-presidential address, "Conservation and the animal biologist," by E. Raymond Hall, University of Kansas, 29 Dec., evening; Raymond C. Moore, University of Kansas, presiding.

Two-session symposium, sponsored by the Division of Biological and Medical Research, Argonne National Laboratory: "Low Level Irradiation"; arranged by Austin M. Brues, Argonne National Laboratory; 30 Dec., morning and afternoon. Part I: "Scientific Presentation"; E. Lawrence Powers, Argonne National Laboratory, presiding. "Natural and artificial radiation background of man," Robert A. Dudley, Massachusetts Institute of Technology; "Discussion of meteorological factors and fallout distribution," Lester Machta, United States Weather Bureau; "Genetic effects of low level irradiation," Earl L. Green, Jackson Memorial Laboratory; "Present status of knowledge of somatic effects of low level irradiation," Austin M. Brues. Part II: "Implications"; Austin M. Brues, presiding. "Radiation as a public health problem," David E. Price, U.S. Public Health Service; "Responsibility of the press," Carl E. Lindstrom, *Hartford Times*; "Legal and political implications," Hon. Chet Holifield, California, U.S. House of Representatives; "Morality and scientific decisions," C. West Churchman, School of Business Administration, University of California, Berkeley.

Society of Systematic Zoology. Contributed papers, 28 Dec., morning.

Biological Sciences

Biometric Society, Eastern North American Region. Special address, cosponsored by the Ecological Society of America: "Smoking and lung cancer: An example of the interpretation of statistical data in the observational sciences," by Sir Ronald A. Fisher, Cambridge University; 27 Dec., morning; Boyd Harshbarger, Virginia Polytechnic Institute, presiding.

Contributed papers, 27 Dec., afternoon; T. A. Bancroft, Iowa State College, presiding.

Ecological Society of America. Contributed papers in plant ecology, 28 Dec., morning.

Contributed papers in animal, general, and human ecology, 28 Dec., morning.

Invited papers on sexual behavior, sponsored by the Section on Animal Behavior and Sociobiology, Ecological Society of America; 29 Dec., afternoon; A. M. Guhl, Kansas State College, presiding. "The development of sexual behavior," Evelyn Shaw, American Museum of Natural History; "Endocrine control of sexual behavior," Adam Anthony, Pennsylvania State University; "Stimulus control of sexual behavior," E. B. Hale, Pennsylvania State University; "Induced sexual responses by infracranial chemical stimulation," Alan Fisher, University of Pittsburgh; "Comparative studies of sexual behavior," John A. King, Jackson Memorial Laboratory.

National Association of Biology Teachers. "Session on Outdoor Biology," arranged by Irene Hollenbeck, Southern Oregon College; 27 Dec., morning; Howard Weaver, University of Illinois, presiding. "Planning better outdoor laboratories for schools," John W. Brainerd, Springfield College; "Soil studies in high-school biology," H. Seymour Fowler, Pennsylvania State University; "Physical limnology as a part of high-school biology," John C. Ayers, University of Michigan; "Aquatic biology field trips," Walter H. Brown, Illinois State

Normal University; "Ornithology out-of-doors," Rex Conyers, Senior High School, University City, Missouri; "Teaching ecological principles in high-school biology," Robert A. Bullington, Northern Illinois State College.

Symposium, jointly with American Nature Study Society, National Association for Research in Science Teaching, and National Science Teachers Association: "Teaching the Major Concepts"; arranged by Paul Klinge, Indiana University, who will preside; 28 Dec., morning. Part I: "Relativity," Emil J. Konopinski, Indiana University; George G. Mallinson, Western Michigan College, presiding. Part II: "Evolution," Edward O. Dodson, University of Ottawa; John Breukelman, State Teachers College, Emporia, Kansas, presiding. Part III: "Individuality of Man," Ralph Tyler, Center for Advanced Study in the Behavioral Sciences, Stanford; Richard L. Weaver, University of Michigan, presiding.

Symposium: "Methods and Techniques—Problem-Solving in Biology"; arranged by Irene Hollenbeck; 28 Dec., afternoon; Frances L. Hall, Columbia University, presiding. "Teaching problem-solving," J. Darrell Barnard, New York University; "Original research experiences directing high-school students toward professional careers in science," Wallace M. Good, Wyandotte High School, Kansas City, Kansas; "Stimulating interest in science through special projects," Dorothy Vaughn, Neodesha High School, Neodesha, Kansas; Panel: "Problem-solving techniques used while studying the heart and circulation," arranged by Marian V. Hamburg, American Heart Association, Inc.

Botanical Sciences

Section G. Contributed papers, 27 Dec., morning; M. Trufant Hall, Butler University, presiding.

Symposium, cosponsored by the American Society of Plant Physiologists, Midwest Section: "Polarity, Heads or Tails?"; 28 Dec., morning, A. C. Leopold, Purdue University, presiding. Introductory remarks, A. C. Leopold; "The morphology of polarity in plants," W. P. Jacobs, Princeton University; "Bioelectric and metabolic factors in polarity," Hilda F. Rosene, Lund Research Laboratory; "Electrokinetics of plant polarity," D. S. Fensom, University of Toronto.

Two-session symposium, jointly with Section F and cosponsored by the Ecological Society of America, Genetics Society of America, American Society of Naturalists, American Society of Zoologists, Botanical Society of America, and the American Society of Plant Physiologists, Midwestern Section: "Some Unsolved Problems in Biology, 1957," Part II: "Biochemistry and Embryology," arranged by Barry Commoner, Washington University, who will preside; 29 Dec., morning. "The biosynthesis of proteins," Felix Haurowitz, Indiana University; "Photosynthesis," Hans Gaffron, University of Chicago; "Inheritance in somatic cells," Robert W. Briggs, Indiana University; "The nature of cellular interaction during regeneration," S. Meryl Rose, University of Illinois.

Contributed papers; 29 Dec., afternoon; Harry J. Fuller, University of Illinois, presiding.

Botanists' dinner and vice-presidential address: "Casual ablutions," by Harry J. Fuller; 29 Dec., evening; Barry Commoner, presiding.

Engineering

Section M. Two-session symposium: "Man and His Environment," arranged by a committee, Carl F. Kayan, Columbia University, chairman; 30 Dec., morning and afternoon. Part I, cosponsored by the American Meteorological Society and the American Geophysical Union: "Outdoor Environment"; George M. Hawkins, Purdue University, presiding. "Man's adaptation to outdoor environment," Raymond C. Wanta, Robert A. Taft Sanitary Engineering Center; "Meteorological measurements in relation to weather," Edward M. Brooks, St. Louis University; "Organization of weather data for short- and long-range predictions," Robert D. Fletcher, Andrews Air Force Base; "Prerequisites for weather control," Bernard Vonnegat, Arthur D. Little, Inc. Part II, cosponsored by the American Industrial Hygiene Association: "Indoor Environment"; Carl F. Kayan, presiding. "Engineering aspects of indoor comfort data," Charles S. Leopold, consulting engineer; "Problems of industrial noise," Charles R. Williams, Liberty Mutual Insurance Company; "Problems of light and glare," Sylvester K. Guth, General Electric Company; "Air contaminants in indoor atmosphere," Charles D. Yaffe, U.S. Public Health Service.

Medical Sciences

Section N. Four-session symposium, cosponsored by the American Medical Association Committee on Cosmetics and the Society for Investigative Dermatology: "The Human Integument—Normal and Abnormal"; arranged by a committee, Stephen Rothman, University of Chicago, chairman; 28 and 29 Dec., morning and afternoon, Stephen Rothman, presiding. Part I: "The Integument as an Organ of Protection." "Relation of the anatomy of normal and abnormal skin to its protective function," Richard B. Stoughton, University Hospitals of Cleveland; "Protection against the transfer of molecules and energy," Robert D. Griesemer, Harvard Medical School; "Protection against the invasion of bacteria and fungi," Irvin H. Blank, Harvard Medical School. Part II: "Circulation and Vascular Reactions." "The structural aspects and hemodynamics of skin circulation, pharmacological effects," Benjamin W. Zweifach, New York College of Medicine; "Physiology of cutaneous circulation: effect of cold and heat, thermal regulatory functions," Alan C. Burton, University of Western Ontario; "Pathology and therapy of cutaneous circulatory disorders," Robert R. Kierland, Mayo Clinic. Part III: "Sebaceous Gland Secretion." "Pathological problems involving the sebaceous glands, including acne," Eugene J. Van Scott, National Institutes of Health; "The biochemical and hormonal aspects of sebaceous secretion," Allan L. Lorincz, University of Chicago; "Therapeutic and cosmetic considerations in acne vulgaris," Marion B. Sulzberger, New York University–Bellevue Medical Center. Part IV: "Pathogenetic Factors in Premalignant Conditions and Malignancies of the Skin." "Etiologic factors and pathogenesis of premalignant and malignant lesions of the skin," Raymond R. Suskind and A. Wesley Horton, Kettering Institute; "Clinical, histological, and diagnostic considerations," Hermann Pinkus, Wayne State University; "Prognosis, preventive measures, and treatment," Frederick D. Malkinson, University of Chicago.

Vice-presidential address: "Embryon truth and verities yet in their chaos," by William B. Bean, State University of Iowa College of Medicine; 28 Dec., afternoon; Stephen Rothman, University of Chicago, presiding.

Alpha Epsilon Delta, National Premedical Honor Society. Symposium, cosponsored by Sections C, F, N, and Nd, and Beta Beta Beta Biological Society: "Premedical and Predental Education"; arranged by Christian E. Kaslow, Indiana University, and Maurice L. Moore, Bronxville, New York; 28 Dec., morning; Lloyd R. Gribble, West Virginia University, presiding. Welcoming remarks, J. D. Van Nuys, Indiana University Medical School; introductory remarks, Lloyd R. Gribble; "Coordination and integration of undergraduate and professional education in the health sciences," Herbert E. Longnecker, University of Illinois; "Medical education and the liberal arts college—a report on the Northwestern University project," Richard H. Young, Northwestern University Medical School; panel discussion: "Criteria for admission to medical school," L. H. Baldinger, University of Notre Dame, moderator; panel discussion: "Criteria for admission to dental school," Joseph C. Muhler, Indiana University Dental School, moderator.

Luncheon and address: "Methods of improving liaison and cooperation between medical, dental, and liberal

MAN'S HIGHEST FLIGHT

An exclusive film report by the man who established the world's altitude record for sustained flight—the story of Air Force Major David Simons' flight—and your first look at the earth as it appeared to him through the films made during his 20-mile balloon ascent into space.

MAN'S DEEPEST SEARCH

Through depth blasts on the floor of the ocean, Dr. Maurice Ewing, world-famous geophysicist, reveals the significance of the vast undersea landscape beyond the continental shelf.

MAN'S GREATEST MYSTERY

Nobel Prize-winning biologist, Dr. Wendell Stanley, discloses how science is on the verge of discovering the key to creating life through isolating the tiniest living matter—the virus.

On Sunday afternoon, December 1, CBS Television presents the first in a dramatic series of programs entitled **"CONQUEST"** explaining in understandable terms the crucial scientific developments of our time, with Eric Sevareid, noted CBS News analyst, as host and narrator. Check your newspaper for local broadcast time. **CBS TELEVISION**

arts colleges," by E. W. Shrigley, Indiana University Medical School; 28 Dec., noon; Lloyd R. Gribble, presiding.

American Physiological Society. Two-session symposium, cosponsored by Section N: "Space Medicine"; arranged by Fred A. Hitchcock, Ohio State University, who will preside; 29 Dec., morning and afternoon. Part I. Opening remarks, Fred A. Hitchcock; "Observations made during the Manhigh II flight," David G. Simons, Holloman Air Force Base; "Physiological aspects of Manhigh II," Erwin Archibald, Holloman Air Force Base; "Apparent motion of a fixed luminous target during subgravity trajectories," Grover J. D. Schack, Holloman Air Force Base. Part II: "Radiation hazards in space travel," Abner Golden, Emory University, and Hermann J. Schaefer, U.S. Naval School of Aviation Medicine; "Sealed cabins and artificial atmospheres," James G. Gaume, Martin Company; "Discussion."

American Psychiatric Association. Four-section symposium, cosponsored by Section K and the American Sociological Society: "Rehabilitation of the Mentally Ill: Social and Economic Aspects"; 29 and 30 Dec., mornings and afternoons. Part I: "General Problems"; Benjamin Simon, Ring Sanatorium, presiding. "Rehabilitation of the mentally ill: national aspects," Jack R. Ewalt, Massachusetts Department of Mental Health; "The rehabilitation spectrum," Milton Greenblatt, Massachusetts Mental Health Center; "Rehabilitation potential of the mentally ill," Ernest M. Gruenberg, Milbank Memorial Fund; discussion, Charlotte Schwartz, Joint Commission on Mental Illness and Health, and Robert W. Hyde, Butler Health Center, Providence. Part II: "Hospital Aspects of Rehabilitation"; Richard H. Williams, National Institute of Mental Health, presiding. "Philosophy of rehabilitation with remarks on a pilot study," Harold R. Martin, University of Nebraska College of Medicine; "Pilot study at Boston State Hospital," Ralph Notman, National Institute of Mental Health; "The hospital work program," David Landy, Massachusetts Mental Health Center; "Coordination of ancillary services," William Key; Washburn University; "Relation between dynamic aspects and special hospital activities," E. D. Wittkower, McGill University; discussion, Walter E. Barton, Boston State Hospital, and John Cumming, Psychiatric Receiving Center, Kansas City, Missouri, Part III: "Transition from Hospital to Community"; Milton Greenblatt, presiding. "Vocational rehabilitation: transition from hospital to community," Temple Burling, Cornell University; "Problems in the development of a half-way house," George W. Brooks, Vermont State Hospital; "New Concepts in rehabilitation of the mentally ill in the Veterans Administration, including member-employment and hospital industry." A. B. C. Knudson, Veterans Administration; "Vocational counseling," Joseph F. Sanders, Veterans Administration Hospital; "Fountain House and community aftercare clinics," Donald M. Carmichael, Aftercare Clinics, New York; discussion, Robert T. Hewitt, National Institute of Mental Health, and Donald H. Dabelstein, Office of Vocational Rehabilitation. Part IV: "Community Aspects of Rehabilitation"; Stuart A. Rice, Stuart Rice Associates, presiding. "Implications of rehabilitation with consideration of prevention aspects," Robert C. Hunt, Hudson River State Hospital; "Patterns of posthospital experience," Herbert Naboisek and Ozzie G. Simmons, Harvard School of Public Health; "Patients maintained in the community on tranquilizing drugs," Else B. Kris, Adelphi College; "The protected workshop and other community services," Bertram J. Black, Altro Health and Rehabilitation Services, Inc.; "Employer receptivity," Simon Olshansky, Joint Commission on Mental Illness and Health; discussion, C. Knight Aldrich, University of Chicago.

Dentistry

Section Nd. Three-session symposium, cosponsored by the American College of Dentists, American Dental Association, and the International Association for Dental Research, North American Division: "Physiology and Pharmacology of Fluorides"; 27 Dec., morning and evening, and 28 Dec., morning. Part I, Maynard K. Hine, Indiana University School of Dentistry, presiding: "Fluoride and enzyme inhibition," Walter J. Frajola, Ohio State University; "Essentiality of fluoride in nutrition," Joseph C. Muhler, Indiana University; "Comparison of fluorides as they naturally occur and as they are added in fluoridation," Martin J. Wagner, Indiana University; "Relationship of fluoride and lipid metabolism," Wolfgang Buttner, Indiana University; "The role of fluorides and vitamin metabolism," Paul Phillips, University of Wisconsin. Part II, Joseph C. Muhler, presiding. "The constitutionality of fluoridation," Bernard J. Conway, American Dental Association; "Fluoride toxicity," Frank A. Smith and Harold C. Hodge, University of Rochester School of Medicine and Dentistry; "Fluoride excretion," Edward J. Largent, Ohio State University; "The effects of fluoridation on general health as reflected in mortality data," Thomas L. Hagan, U.S. Public Health Service. Part III, Isaac Schour, University of Illinois School of Dentistry, presiding. "The deposition of fluoride in the human skeleton," I. Zipkin, National Institute of Dental Research; "Fluorides and periodontal health," A. L. Russell, National Institutes of Health; "Fluoride in foods and medicine," Gerald J. Cox, University of Pittsburgh School of Dentistry; "Fluoridation as compared to fluoride preparations for individual use," J. Roy Doty, American Dental Association.

Pharmacy

Section Np. The five programs listed below are cosponsored by the American Pharmaceutical Association, Scientific Section; the American Association of Colleges of Pharmacy; the American Society of Hospital Pharmacists; the American College of Apothecaries; and the National Association of Boards of Pharmacy.

Contributed papers, arranged by John E. Christian, Purdue University; 27 Dec., morning; Robert C. Anderson, Eli Lilly and Company, presiding.

Symposium: "A Pharmacological Approach to Mental Illness"; arranged by Robert C. Anderson, Eli Lilly and Company; 27 Dec., evening; John I. Nurnberger, Indiana University School of Medicine, moderator. "Chemistry," Jack Mills, Lilly Research Laboratories; "Pharmacology," Irwin H. Slater, Lilly Research Laboratories; "Animal behavioral studies," Thom Verhave, Lilly Research Laboratories; "Clinical," Nathan S. Kline, Rockland State Hospital.

Contributed papers: "Hospital Pharmacy"; arranged by George F. Archambault, U.S. Public Health Service, and Joseph A. Oddis, American Hospital Association; 28 Dec., morning; Joseph A. Oddis, presiding.

Contributed papers: "Hospital Pharmacy," and symposium: "Recent Trends in Medications"; arranged by George F. Archambault, Joseph A. Oddis, and Glen J. Sperandio of Purdue University; 28 Dec., afternoon; George F. Archambault, presiding. "Tissue culture: one key to medical progress," Charles J. York, Pitman-Moore Company; "Present concepts of drug therapy in cardiovascular disease," Roy H. Behnke, Veterans Consolidated Hospitals; "Recent trends in pediatric medication," Hugh D. Bryan, Mead Johnson and Company; "Physical compatibilities of some parenteral admixtures." Part I: "Intravenous admixtures." Part II: "Intramuscular admixtures," Robert C. Bogash, Lenox Hill Hospital.

Contributed papers, arranged by John E. Christian; 30 Dec., morning; Karl L. Kaufmann, Butler University School of Pharmacy, presiding.

Round-table discussion; jointly with the Metric Association: "Metric Implementation in Pharmacy, Medicine, and Chemistry"; arranged by J. T. Johnson, the Metric Association, who will moderate; 30 Dec., morning.

Agriculture

Section O. Four-session symposium: "Biological and Chemical Control of Plant and Animal Pests"; 28 Dec., morning and afternoon, 29 Dec., afternoon, and 30 Dec., morning. Part I: "Recent Advances in Chemical Control Measures"; R. L. Lovvorn, North Carolina State College, presiding. "Insecticides," John C. Keller, Agricultural Research Service; "Herbicides," R. H. Beatty, American Chemical Paint Company; "Fungicides and bactericides for control of plant diseases," George L. McNew, Boyce Thompson Institute for Plant Research; "Chemical control of internal parasites of domestic animals," F. O. Gossett, Lilly Research Laboratories; "Systemic antibiotics and chemicals, their movement and mode of action," John E. Casida, University of Wisconsin; questions and discussion. Part II: "Recent Advances in Biological Control Measures"; H. Rex Thomas, Agricultural Research Service, presiding. "Parasites and predators for pest control," Charles A. Fleschner, University of California; "Control of forest insects," J. A. Beal, U.S. Department of Agriculture; "Control of forest diseases," J. R. Hansbrough, U.S. Department of Agriculture; "Pathogens for the control of pests," John D. Briggs, Illinois State Natural History Survey; "Antagonism as a plant disease control principle," William C. Snyder, University of California; "Irradiation for pest control," E. F. Knipling, Agricultural Research Service; questions and discussion. Part III: "Inherent Resistance to Pests"; H. B. Sprague, Pennsylvania State University, presiding. "Disease resistance in animals: some genetic implications of the avian leukosis complex," Nelson F. Waters, Agricultural Research Service; "Breeding plants for resistance to insect pests," Reginald H. Painter, Kansas State College; "Breeding vegetable and fruit crops for resistance to diseases," J. R. Shay, Purdue University; "Breeding field crops for resistance to diseases," Ernest H. Stanford, University of California; "Nutrition of the host and reaction to pests," J. G. Rodriguez, University of Kentucky; questions and discussion. Part IV: "Problems Related to, and Consequences of, Biological and Chemical Control Measures"; T. C. Byerly, Agricultural Research Service, presiding. "Biological balance as affected by disease and insect control practices," A. D. Pickett, Canadian Department of Agriculture; "Exclusion and eradication versus reduction in diseases and pests," M. R. Clarkson, Agricultural Research Service; "Education in the use of pesticides," E. H. Fisher, University of Wisconsin; "Effects of regulatory control on evaluations of safety and suitability," Bernard L. Oser, Food Research Laboratories, Inc.; questions and discussion.

Forthcoming Events

December

19–21. American Physical Soc., Stanford, Calif. (W. A. Nierenberg, Univ. of California, Berkeley 4.)

26–27. Northwest Scientific Assoc., annual, Spokane, Wash. (W. B. Merriam, Geography Dept., State College of Washington, Pullman.)

26–30. American Assoc. for the Advancement of Science, annual, Indianapolis, Ind. (R. L. Taylor, AAAS, 1515 Massachusetts Ave., NW, Washington 5.)

The following 44 meetings are being held in conjunction with the AAAS annual meeting.

AAAS Acad. Conference, annual (Father P. H. Yancey, Spring Hill College, Mobile, Ala.). 28 Dec.

AAAS Cooperative Committee on the Teaching of Science and Mathematics (F. B. Dutton, Dept. of Chemistry, Michigan State Univ., East Lansing). 27 Dec.

Alpha Epsilon Delta (M. L. Moore, 7 Brookside Circle, Bronxville, N.Y.). 28 Dec.

American Astronomical Soc. (J. A. Hynek, Smithsonian Astrophysical Ob-

servatory, 60 Garden St., Cambridge 38, Mass.). 27–30 Dec.

American Geophysical Union (E. M. Brooks, Dept. of Geophysics, St. Louis Univ., St. Louis 8, Mo.).

American Medical Assoc. Committee on Cosmetics (Mrs. V. L. Conley, AMA, 535 N. Dearborn St., Chicago, Ill.). 28–29 Dec.

American Meteorological Soc. (K. C. Spengler, AMS, 3 Joy St., Boston, Mass.)

American Nature Study Soc., annual (R. L. Weaver, School of Natural Resources, Univ. of Michigan, Ann Arbor). 26–30 Dec.

American Physiological Soc. (F. A. Hitchcock, Dept. of Physiology, Ohio State Univ., Columbus 10).

American Political Science Assoc. (C. S. Hyneman, Dept. of Government, Indiana Univ., Bloomington). 29 Dec.

American Psychiatric Assoc. (M. Greenblatt, Massachusetts Mental Health Center, 74 Fenwood Rd., Boston 15). 29–30 Dec.

American Soc. of Hospital Pharmacists (G. E. Archambault, Pharmacy Branch, U.S. Public Health Service, Washington 25).

American Soc. of Naturalists (B. Wallace, Biological Lab., Cold Spring Harbor, Long Island, N.Y.).

American Sociological Soc. (V. H. Whitney, Brown Univ., Providence, R.I.). 28 Dec.

American Statistical Assoc. (V. L. Anderson, Statistical Lab., Purdue Univ., Lafayette, Ind.).

Association of American Geographers (L. L. Ray, U.S. Geological Survey, Washington 25).

Association for Computing Machinery (J. E. Robertson, Digital Computer Lab., Univ. of Illinois, Urbana).

Astronomical League (W. Garnatz, 2506 South East St., Indianapolis.)

Beta Beta Beta (Mrs. F. G. Brooks, P.O. Box 336, Madison Sq. Station, New York 10). 27 Dec.

Biometric Soc., ENAR (T. A. Bancroft, Dept. of Statistics, Iowa State College, Ames).

Conference on Scientific Editorial Problems, annual (G. L. Seielstad, Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.). 26–30 Dec.

Conference on Scientific Manpower, annual (T. J. Mills, National Science Foundation, Washington 25). 30 Dec.

Ecological Soc. of America (A. A. Lindsey, Dept. of Biological Sciences, Purdue Univ., Lafayette, Ind.). 27–29 Dec.

Metric Assoc. (J. T. Johnson, 694 West 11 St., Claremont, Calif.).

National Acad. of Economics and Political Science (D. P. Ray, Hall of Government, George Washington Univ., Washington, D.C.).

National Assoc. of Biology Teachers, annual (Miss I. Hollenbeck, Southern Oregon College of Education, Ashland). 26–31 Dec.

National Assoc. for Research in Science Teaching (G. G. Mallinson, Western Michigan College, Kalamazoo). 26–30 Dec.

National Assoc. of Science Writers (J. Troan, *Pittsburgh Press*, Pittsburgh, Pa.).

National Council of Teachers of Mathematics (P. Peak, College of Education, Indiana Univ., Bloomington). 27 Dec.

National Foundation for Junior Museums (J. R. Forbes, NFJM, 114 E. 30 St., New York 16). 26, 28 Dec.

National Geographic Soc. (W. R. Gray, NGS, 16th and M Sts., NW, Washington 6). 29 Dec.

National Science Teachers Assoc. (R. W. Schulz, Emmerich Manual Training High School, 2405 Madison Ave., Indianapolis 25). 26–30 Dec.

National Speleological Soc. (Brother G. Nicholas, LaSalle College, 20th and Olney Aves., Philadelphia 41, Pa.). 28 Dec.

Philosophy of Science Assoc. (C. W. Churchman, Case Inst. of Technology, Cleveland, Ohio).

Scientific Research Soc. of America, annual (D. B. Prentice, 56 Hillhouse Ave., New Haven 11, Conn.). 27 Dec.

Sigma Delta Epsilon, annual (Miss M. Chalmers, Dept. of Chemistry, Purdue Univ., Lafayette, Ind.). 26–30 Dec.

Sigma Pi Sigma (M. W. White, Pennsylvania State Univ., University Park). 27 Dec.

Society for the Advancement of Criminology (D. E. J. MacNamara, New York Inst. of Criminology, 40 E. 40 St., New York 16). 27–28 Dec.

Society for General Systems Research, annual (R. L. Meier, Mental Health Research Inst., Ann Arbor, Mich.).

Society for Industrial Microbiology, Washington Section (W. N. Ezekiel, Bureau of Mines, Washington 25).

Society for Investigative Dermatology (H. Beerman, Univ. of Pennsylvania School of Medicine, Philadelphia 3). 28–29 Dec.

Society of the Sigma Xi, annual (T. T. Holme, 56 Hillhouse Ave., New Haven 11, Conn.). 27 Dec.

Society of Systematic Zoology, annual (R. E. Blackwelder, Box 500, Victor, N.Y.). 26–31 Dec.

United Chapters of Phi Beta Kappa, annual address (C. Billman, 1811 Q St., NW, Washington, D.C.). 27 Dec.

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27. Association for Symbolic Logic, Cambridge, Mass. (J. Barlaz, Rutgers Univ., New Brunswick, N.J.)

27–28. Linguistic Soc. of America, Chicago, Ill. (A. A. Hill, Box 7790, University Station, Austin 12, Tex.)

27–30. American Finance Assoc., annual, Philadelphia, Pa. (G. E. Hassett, Jr., New York Univ., 90 Trinity Pl., New York 6.)

28–29. American Folklore Soc., annual, Chicago, Ill. (M. Leach, Box 5, Bennett Hall, Univ. of Pennsylvania, Phila. 4, Pa.)

28–30. American Anthropological Assoc., annual, Chicago, Ill. (W. S. Godfrey, Jr., Logan Museum, Beloit College, Beloit, Wis.)

28–30. American Economic Assoc., annual, Philadelphia, Pa. (J. W. Bell, Northwestern Univ., Evanston, Ill.)

28–30. Archaeological Inst. of America, annual, Washington, D.C. (C. Boulter, 608, Univ. of Cincinnati Library, Cincinnati 21, Ohio.)

(See issue of 15 November for comprehensive list)

EQUIPMENT NEWS

The information reported here is obtained from manufacturers and from other sources considered to be reliable. Science *does not assume responsibility for the accuracy of the information. All inquiries concerning items listed should be addressed to* Science, *Room 740, 11 W. 42 St., New York 36, N.Y. Include the name(s) of the manufacturer(s) and the department number(s).*

■ FREEZE DRYER for biological tissues and other heat-sensitive materials uses a glass vacuum system divided into replaceable units connected by ball-and-socket joints. Vacuum is provided by a diffusion pump of 60 lit/min capacity at 1 μ, backed by a mechanical pump with free air capacity of 58/lit min. Specimens are frozen by a mixture of Dry Ice and trichloroethylene. Moisture is collected by a liquid-nitrogen cold finger. (Fisher Scientific Co., Dept. S734)

■ X-RAY DIFFRACTOMETER designed for powder diffraction work can accommodate high- and low-temperature chambers, devices for preferred orientation and pole-figure studies, and focussing monochromators. Scintillation-, proportional-, flow-, or Geiger-counter units provide a choice of detectors for all conditions. Goniometer scanning is done in a vertical plane at any of five selectable speeds. X-ray tubes with four windows permit simultaneous use of four cameras. Useful diffraction range is from −38 to +165 deg. (Philips Electronics Inc., Dept. S736)

■ INDUCTANCE BRIDGE measures from 1 μhy to 100 hy with resolution of 0.01 percent. Direct-reading accuracy is achieved between 50 and 3000 cy/sec; a table of corrections permits measurement to 20 kcy/sec. The internal standard is a four-dial inductance of 0.05-percent accuracy. External standards of higher accuracy can be furnished. Accessories permit measurement of inductance with up to 2 amp of superimposed direct current and of capacitance from 10 pf to 1 μf with accuracy of 0.2 percent. (British Industries Corp., Dept. S742)

■ OPTICAL TESTER is based on the method of Ronchi and Lenouvel in which the optical element to be tested is illuminated and viewed through a grating. The shadow lines or fringes produced provide information on the quality of the optical element. The tester, consisting of an illuminator and grating, may be hand held or clamped in position. (Ann Arbor Optical Co., Dept. S694)

■ AUTOCOLLIMATOR is servo operated and provides automatic, direct indication of angular displacement. Range is ±1 min of arc with sensitivity 0.1 sec. Accuracy

is ±0.5 percent. Response time is 0.1 sec/sec of arc, and warm-up time is eliminated by use of transistor circuitry. Output may be read visually on a calibrated dial, one revolution of which indicates 10 sec of arc, or an electrical signal, proportional to dial rotation, may be obtained from a potentiometer on the dial shaft. When it is operated at 125 v, the potentiometer furnishes output of 800 mv/sec of arc. (Davidson Manufacturing Co., Dept. S744)

■ OSCILLOGRAPH provides 36 channels of immediately visible photographic recording. Frequency range is from d-c to 3000 cy/sec. Chart paper is 12 in. wide; 8-in. peak-to-peak deflection is permitted in each channel. Traces are identified to permit overlap. Recording speeds range from 0.1 to 160 in./sec. Writing speed is up to 20,000 in./sec. Grid lines and timing lines are recorded optically, simultaneously with galvanometer traces. The daylight-loading paper carrier accommodates 200 ft of chart. (Minneapolis Honeywell, Dept. S745)

■ COORDINATE CONVERTER converts polar-coordinate input to Cartesian-coordinate output. Conversion is achieved by a sine-cosine potentiometer linked to a null-seeking servo. The potentiometer resolves the input into quadrature components according to angular position. Speed of potentiometer positioning is 360 deg/sec. Sensitivity is 0.5 mv/deg. (Mandrel Industries Inc., Dept. S748)

■ OXIMETER requires blood samples of less than 1 ml. The instrument reading is displayed on a panel meter or may be used to drive a standard recorder directly. Ranges are 0 to 50, 50 to 100, and 0 to 100 percent oxygen saturation. (American Electronic Laboratories, Inc., Dept. S750)

■ STATIC ELECTRICITY MEASURING INSTRUMENT determines static potential on the basis of the ionization of air in the vicinity of the charge, by which a sample of the charge is conducted to the instrument. Range is 0 to 500 kv. Attachments make it possible to measure in inaccessible areas. The instrument is hand-held. (United States Radium Corporation, Dept. S751)

■ AUTOCLAVE uses a single dial to control the sterilizing cycle, including filling, standby service, sterilizing, and venting. Internal pressure is variable from 7 to 27 lb/in.², corresponding to steam temperatures of 230 to 270°F. Safety features include pressure-safe door which cannot be opened until pressure is relieved, low-water cut-off, and relief valve. Dimensions are approximately 24 by 14 by 19 in. Capacity is 1017 in.³ (Wilmot Castle Co., Dept. S752)

■ SAMPLE COOLER is designed for pressures up to 5000 lb/in.² (gage) and temperatures to 1200°F. The heat exchanger is of the shell-and-tubular-coil type. Material is stainless steel, heliarc-welded. The outer shell is 3½ in. in diameter by 11¼ in. long. (Technical Engineered Products Inc., Dept. S754)

■ COLORIMETER balances automatically to measure color of transparent materials from 400 to 800 mμ. Reproducibility of reading is 0.25 percent. Sensitivity is one per million or less. Interference filters are used to select wavelength of illumination. Cylindrical cells 22 mm in diameter or larger, and up to 15 cm long, can be accommodated. Output for a separate millivolt recorder is available. (Mission Instrument Co., Dept. S755)

■ BEAKERS of fluorocarbon resin are chemically inert at temperatures to 500°F, except to molten alkali metals, fluorine, and certain fluorine compounds. They are not affected by aqua regia, hydrofluoric acid, hot caustics, or organic solvents. Capacities are 250, 500, and 1000 ml. (Resistoflex Corporation, Dept. S757)

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POSITIONS WANTED

Biochemist, Ph.D., age 35, experienced in tissue culture. Research or research and teaching position desired. Box 294, SCIENCE. 11/22

Medical Editor, Writer; training, experience in nutritional biochemistry; seeks association with clinical, research program. Box 298, SCIENCE. X

Microbiologist, Ph.D., virology, cellular metabolism, genetics; biochemical, biophysical techniques; medical teaching and research experience; seeking more active position; can do. Box 295, SCIENCE. 11/29

Physiologist–Zoologist; Ph.D., 1953; 5 years of teaching experience (university and medical) in general and mammalian physiology; research, publications. Desires change in academic position. Box 296, SCIENCE.

Young Microbiologist is available for half-time opportunity in administration or teaching and half-time research; 5 years as assistant professor of biology, university medical school. Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

POSITIONS OPEN

PINEAPPLE AGRONOMIST

Applications are invited for a Pineapple Agronomist at a recently established experiment station on deep peat soil in Johore, Federation of Malaya. The agronomist will be required to take charge of the station and to plan, execute, and report experimentation in the cultivation of pineapples on deep peat soils recently cleared of forest. Candidates should have a degree in agriculture or the agricultural sciences and postgraduate training in crop agronomy and experimental methods. Experience in tropical crop experimentation will be an advantage. Salary at present exchange rates £3360 per annum; passage paid for appointee, wife, and children on first appointment and on final retirement. Leave with pay 45 days per year accumulatable up to 4 years. Provident Fund deductable at 5 percent per year—employer contributing for 1 to 10 years' service, 10 percent; 11 to 20 years' service, 15 percent; and 21 years plus service, 20 percent. House provided on station in Johore (approximately 50 miles from center of Singapore) at monthly rent of £8 15s; medical and hospitalization fund. Salary liable to income tax at present rates of approximately £360 per annum for married man with one child. For further details write: Chief Executive Officer, Malayan Pineapple Industry Board, Government Offices Building, Johore Bahru, Johore, Federation of Malaya. X

Cacao Research Scientists, especially geneticists, entomologists, or pathologists, required by Inter-American Institute of Agricultural Sciences, Turrialba, Costa Rica, to work in Costa Rica or other Latin American countries. Research experience in the tropics, especially with tree crops, an advantage. The Institute is an international specialized agency of the Organisation of American States conducting research, training, and consultation services for Latin America. Salary according to qualifications and experience. Further details and application forms on request. Contact Gordon Havord, Head, Cacao Center, at above address. X

POSITIONS OPEN

(a) Chemists; B.S., M.S. experienced micromethods, clinical chemistry for pediatric microbiochemistry laboratory; teaching hospital for important western university medical school; duties include research, patient service. **(b) Bacteriologist;** M.S. or Ph.D. to direct department, very large general hospital; $7500–$8400; Midwest. **(c) Chemist;** college graduate, experienced clinical chemistry; also supervise general laboratory, 150-bed general hospital; to $7000; rural New England. **(d) Pharmacology–Physiology Instructor;** young Ph.D. interested affiliating outstanding eastern medical school; to $5500. **(e) Microbiologist;** Ph.D. specialized virology and/or experimental immunology; university medical school faculty; to $6500; Southeast. Woodward Medical Bureau, Ann Woodward, Director, 185 N. Wabash, Chicago. X

Electron Microscopist. An electron microscopist is needed at the biological laboratories of Harvard University, Cambridge 38, Mass., to collaborate in research with members of the department. Salary to depend upon experience and other qualifications. Inquiries should be addressed to the Chairman, Electron Microscope Committee, at the above address. 11/29; 12/6, 13

Free-Lance Writer. Experienced. Strong background in medical or ancillary sciences. Will need facilities of medical library. Must be able to write upon assignment and meet deadlines. Medical Arts Publishing Foundation. 1603 Oakdale Street, Houston 4, Texas. 11/22, 29; 12/6

(a) Head, Department of Biological Sciences; duties involve supervision and scientific leadership of established group of professional and supporting personnel; should be specialist in one of biological sciences, Ph.D. or M.D.; considerable industrial experience required; one of leading research companies; outstanding opportunity. **(b) Biochemist,** B.S. degree, with training or experience in protein and enzymes; duties consist of supervising biochemical manufacturing and research; East; $8000. **(c) Clinical Psychologist;** important guidance clinic; $7000–$9300; South. **(d) Clinical Physiologist** trained in immunology or chemistry; head department, medical school and teaching hospital; West. S11-4 Medical Bureau, Burneice Larson, Director, 900 North Michigan Avenue, Chicago. X

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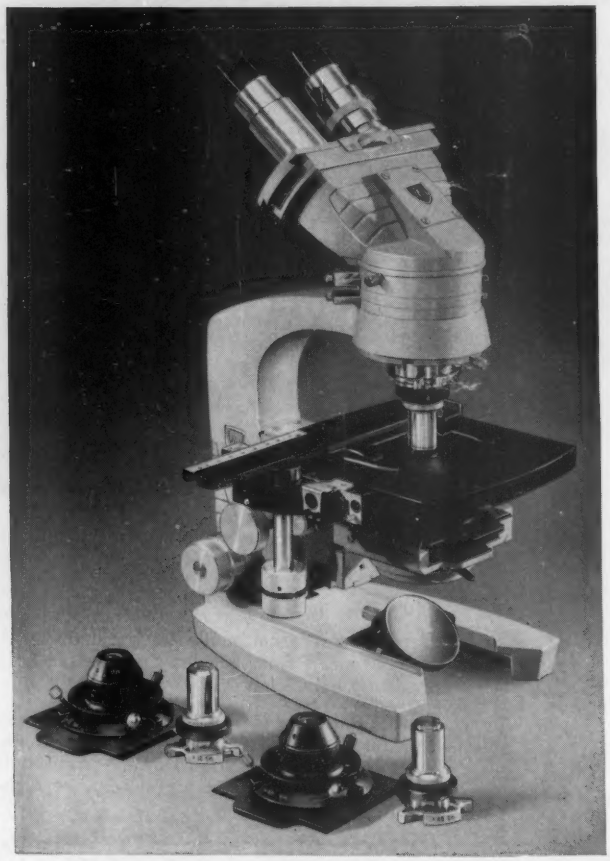

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